Predicted Impact of Reducing Gillnet Mesh Size on the Efficiency of the Great Slave Lake Commercial Lake Whitefish, *Coregonus clupeaformis* (Mitchill), Fishery, Northwest Territories

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by

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Abstract

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Great Slave Lake, Northwest Territories, supports a substantive and stable commercial fishery which has been in operation since 1945 and is managed by DFO in consultation with the Great Slave Lake Advisory Committee (G.S.L.A.C.). In 1996, G.S.L.A.C. asked the Department of Fisheries and Oceans (DFO) for advice on improving the efficiency of the commercial gillnet fishery by reducing the legal commercial mesh size and on the effect of mesh reduction on sustainability of the fishery. In response to this request, DFO conducted multi-mesh experimental gillnet studies on the lake in the summers of 1997 and 1998 to evaluate the effects on fishing efficiency of a relatively small reduction in stretched measure mesh size from 133 mm to 127 mm proposed by G.S.L.A.C.. The target species of the fishery, lake whitefish (*Coregonus clupeaformis*, Mitchill), accounts for between 70 to 95% of the total round weight of all species harvested annually. Therefore, the study examined the effects of mesh reduction on fishing efficiency for lake whitefish only. Fishing efficiency was defined as total round weight and total value of all lake whitefish caught per net lift. Mesh size and fishing efficiency were significantly correlated with the total round weight of lake whitefish caught per net lift and total value (Canadian Dollars) of lake whitefish caught per net lift. The total round weight CPUE was highest for the 89 and 121 mm meshes while the total value CPUE was highest for the 121 and 127 mm meshes. Results of the study suggest that reducing the legal commercial mesh size on Great Slave Lake from 133 to 127 mm will improve fishing efficiency by 45.8% for total round weight CPUE and 30.4% for total value CPUE. Sampling location had a significantly greater effect on fishing efficiency than did mesh size. Therefore, fishers should not expect improvement in fishing efficiency, after mesh reduction, for all fishing locations. Mesh reduction should not reduce sustainability of the fishery if the present commercial quotas remain unchanged.

Key words: Great Slave Lake; Northwest Territories; lake whitefish; commercial fishery; mesh size; gillnets; fishing efficiency; gillnet selectivity.

Résumé

Day, A.C. 2002. Predicted impact of reducing gillnet mesh size on the efficiency of the Great Slave Lake commercial lake whitefish, *Coregonus clupeaformis* (Mitchill), fishery, Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 2440: vii + 45 p.

Le Grand lac des Esclaves, dans les Territoires du Nord-Ouest, alimente, depuis 1945, une importante pêche commerciale stable, gérée par le ministère des Pêches et des Océans (MPO) en collaboration avec le Comité consultatif du Grand lac des Esclaves. En 1996, le Comité a demandé au MPO des conseils à savoir si une réduction de la largeur réglementaire des mailles des filets de pêche commerciale permettrait d'améliorer l'efficience de pêche et quel serait l'effet d'une telle réduction sur la durabilité de la pêche. En réponse à cette demande d'avis, le MPO a effectué au cours de l'été 1997 et 1998 des expériences de pêche aux filets maillants expérimentaux à multiples maillages en vue d'évaluer les effets d'une réduction relativement faible de la longueur de maille, soit de 133 mm à 127 mm, proposée par le Comité. Comme le grand corégone (*Coregonus clupeaformis*, Mitchill), l'espèce-cible de la pêche, constitue de 70 à 95% du poids brut total de toutes les espèces prélevées annuellement, l'étude a porté sur un examen des effets d'une réduction du maillage sur l'efficience de pêche en regard de cette espèce seulement. L'efficience de pêche est définie comme le poids brut total et la valeur totale de tous les corégones capturés dans chaque filet relevé. Il existait une corrélation significative entre, d'une part, le maillage et l'efficience de pêche et, d'autre part, le poids

brut total des prises par filet relevé et la valeur totale (en dollars canadiens) des corégones capturés dans chaque filet relevé. Les maillages de 89 mm et 121 mm ont donné la PUE en poids brut total la plus élevée et les maillages de 121 mm et 127 mm, la PUE en valeur totale la plus élevée. Les résultats de l'étude donnent à penser qu'une réduction du maillage commercial réglementaire pour le Grand lac des Esclaves, soit de 133 mm à 127 mm, permettra de majorer l'efficience de pêche par 45.8% dans le cas de la PUE en poids brut total et par 30.4% dans le cas de la PUE en valeur totale. Comme les points d'échantillonnage avaient une incidence nettement plus marquée sur l'efficience de pêche que le maillage, les pêcheurs ne devraient pas s'attendre à ce qu'elle s'améliore, suite à une réduction du maillage, à tous les endroits. Une réduction du maillage ne devrait pas donner lieu à une baisse de la durabilité de la pêche si les quotas de pêche commerciale en place restent les mêmes.

Mots-clés: Grand lac des Esclaves; Territoires du Nord-Ouest; grand corégone; pêche commerciale; maillage; filets maillants; efficience de pêche; sélectivité des filets maillant.

Introduction

The relative importance of the Great Slave Lake commercial fishery and the lake whitefish production of this fishery are readily apparent in the Northwest Territories fisheries harvest and landed value statistics. In the 1996/97 fiscal year (the most recent year for which published information is available), the total harvest from Great Slave Lake accounted for 53% by landed round weight and 43% by landed value of all fish species harvested by all commercial and experimental fisheries in the NWT and Nunavut. In the same year, the whitefish harvest from Great Slave Lake accounted for 40% by landed round weight and 34% by landed value of all fish species harvested by all commercial and experimental fisheries in the NWT and Nunavut (Department of Fisheries and Oceans, 1999). Aboriginal subsistence and sport fishery harvests from Great Slave Lake are very small relative to the commercial harvest. Estimated to be equal to less than 5% of commercial harvests, these fisheries are nonetheless of great socio-economic importance to communities surrounding the lake.

The Department of Fisheries and Oceans (DFO), in consultation with the Great Slave Lake Advisory Committee (G.S.L.A.C.), manage all fisheries on Great Slave Lake. In 1996 G.S.L.A.C. asked DFO for advice in regards to increasing the efficiency of the commercial gillnet fishery by reducing the legal commercial mesh size. Committee members stated that prolonged periods of fishing were reducing commercial fishers' profits due to the high operating costs associated with fishing on Great Slave Lake. General questions asked by the committee were would a reduction in mesh size significantly increase the efficiency of the fishery and what effects would a reduction in mesh size have on the sustainability of the fishery? Prior to the completion of this report, DFO recommended a reduction from 133 mm (5 ¼ inch) stretched measure mesh size to 127 mm (5 inch) because it was believed that this relatively small reduction would not adversely affect the sustainability of the lake whitefish fishery. However, it was not known if this reduction would significantly increase the efficiency of the fishery.

Past multi-mesh experimental assessments conducted in Great Slave Lake (Bond and Turnbull 1973, Bond 1975, Moshenko and Low 1978 and Roberge et al. 1985) were designed to track changes in population parameters of all species relative to estimates made in earlier studies. As such, the information generated by these earlier experimental assessments was general in nature and lacked the experimental design required to conduct robust statistical comparisons of fishing efficiency (CPUE) amongst various mesh sizes. Moshenko and Low (1978) provided detailed information on gillnet selectivity via capture girth, opercle girth and maximum girth measurements and on method of capture (wedged or caught by the opercles) but sample sizes for whitefish caught at 4 locations in the 127 mm (5 inch) and 133 mm (5 ¼ inch) meshes were too small for a reliable estimation of fishing efficiency (n = 217 and 139 for the 127 and 133 mm meshes respectively for all locations combined).

In response to G.S.L.A.C.'s request for advice, DFO conducted experimental netting on Great Slave Lake in 1997 and 1998. This experimental assessment was designed specifically to assess the effect of mesh reduction on fishing efficiency and sustainability of the fishery.

The objectives of this experiment were to 1) quantify the relationship between fishing efficiency and various mesh sizes and 2) to determine if reducing the mesh size from 133 mm (5 ¼ inch) to 127 mm (5 inch) would significantly increase the catch per unit of effort (CPUE) of the fishery without threatening sustainability of the fishery. In context of the study objective, fishing efficiency was evaluated as both total round weight and total value (Canadian Dollars) of lake whitefish caught per unit of effort.

Study Area

Great Slave Lake lies in the southwest corner of the District of Mackenzie, Northwest Territories, Canada. It is the fifth largest lake in North America, with

a surface area of 27,195 km^2 and a drainage area of 985,300 km^2. Stretching 440 km from its extreme east end to the outlet of the Mackenzie River, the lake straddles two physiographic regions. The northeast shore of the north arm and the east arm lie within the Precambrian shield and have irregular precipitous margins. The western portion of the lake overlies the alluvial plain known as the Mackenzie Lowlands and has few islands and gently sloping shores. The rivers entering the lake from the Shield are cold, clear and rapidly flowing while those entering the lake from the south shore are slow flowing and laden with silt. While the western basin has a maximum depth of 165 m and a mean depth of 42 m, a depth of 625 m has been recorded in the east arm (Figure 1). The physical and biological characteristics of the lake have been previously described in detail by Rawson (1950, 1951, 1953a and 1953b).

Description of the Fishery

There are at least 25 fish species in the lake (Keleher 1972) of which only 7 are of commercial importance. In the 2000/2001 fishing year, species which contributed to commercial production were, in order of decreasing contribution; lake whitefish (*Coregonus clupeaformis*, Mitchill), burbot (*Lota lota*, Linnaeus), northern pike (*Esox lucius*, Linnaeus), lake trout (*Salvelinus namaycush*, Walbaum), inconnu (*Stenodus leucichthys nelma*, Pallas), longnose sucker (*Catastomus catastomus*, Forster) and walleye (*Stizostedion vitreum vitreum*, Mitchill).

The lake is divided into six administrative areas for management purposes with a portion of the total annual commercial quota (1,727,400 kgs) allotted to each area (Figure 1). Annual quotas are assigned on a per fishing year basis. A fishing year is the period commencing on November 1st and ending on October 31st of the following year. A fishing year is divided into summer and winter periods which are described by Moshenko et al. (1978). Detailed histories of the commercial fishery are given by Kennedy (1956), Keleher (1972), Bond and Turnbull (1973) and Day and Low (1992).

The legal minimum stretched measure mesh size of the commercial fishery was 139 mm (5 ½ inch) from 1945 to 1976 in all commercially fished management areas of the lake. In 1977 it was lowered to 133 mm (5 ¼ inch) in all commercially fished management areas of the lake. In November of 1997 it was lowered to 127 mm (5 inch) in management Areas I east, II, III and IV. It was lowered to 127 mm in management area I west in May of 2000 and in November of 2000 in management area V.

Lake whitefish is the target species of the commercial fishery. In the past, lake trout were also a target species but by the late 1960's lake trout stocks in the western basin of the lake had collapsed due to overexploitation. At the onset of the commercial fishery, the proportion with respect to round weight harvested, of whitefish to lake trout was approximately 1.4/1 but increased in favor of whitefish to approximately 12/1 by the late 1960's and has remained at this proportion to the present. The western basin of the lake is now being managed for commercial lake whitefish production with minimal regard to the collapsed lake trout stocks. The east arm of Great Slave Lake (Area VI) was completely closed to commercial fishing in 1974 and is being managed exclusively for Aboriginal subsistence fishing and sport fishing primarily for lake trout (Moshenko and Gillman 1978).

Commercial production of all species combined peaked at 4,500,000 kgs in the 1949/50 fishing year then declined steadily to 1,300,000 kgs per year by the mid 1970's. From the mid 1970's to the present, commercial production of all species combined has remained at lower levels which have varied from year to year between 1,150,000 and 2,000,000 kgs. (Day and Low 1992). In the past 35 years, annual commercial whitefish production has accounted for 70 to 95% of the Great Slave Lake commercial production of all species combined.

From the early to mid 1970's, annual commercial production has been below area quotas with the exception of area I West. The ease and low cost of transporting harvests to the Hay river fish

plant, which is relatively close to area I West, has resulted in this area being traditionally fished to its full quota. In the 2000/2001 fishing year, three quarters of the total annual lake quota was harvested.

Methods

Field Work

In 1997 and 1998, multi-mesh gangs of gillnets were set at 7 sampling locations on Great Slave Lake (Table 1). Logistics did not permit mesh size efficiency to be assessed in all management areas of this large lake so three of the five commercially fished management areas were chosen for sampling. The areas chosen represented a range of fishing intensities with intensity being defined as that proportion of the management area annual quota which had been traditionally harvested by the commercial fishery. Sampling occurred in Area I West (high fishing intensity), Area II (moderate fishing intensity) and Area III (light fishing intensity). Sampling locations within management areas were at sites where commercial fishing has traditionally occurred (Figure 1).

Gillnet gangs consisted of 3 to 6 nets connected together, each net being of a different mesh size. Mesh sizes of the nets, expressed as stretched measure, were 89 mm (3 ½ inch), 114 mm (4 ½ inch), 121 mm (4 ¾ inch), 127 mm (5 inch), 133 mm (5 ¼ inch) and 139 mm (5 ½ inch). A total of 157 gillnet gangs were set and lifted in this study, with 90 and 67 gangs set and lifted in 1997 and 1998 respectively. In 1997, 43 gangs were composed of all 6 mesh sizes, 43 were composed of mesh sizes 127, 133, and 139 mm, 3 were composed of mesh sizes 114, 133 and 139 mm and 1 was composed of mesh sizes 114, 127, 133, and 139 mm. In 1998, 49 gangs were composed of all 6 mesh sizes and 18 were composed of mesh sizes 127, 133, and 139 mm. Small sized meshes of 38 mm (1 ½ inch) and 64 mm (2 ½ inch), usually components of experimental gangs, were not used in gangs fished in this study because their catches are usually relatively low. Twine size of all nets was .210 mm, 3 strand nylon. A gap of 2.5 meters was placed between different mesh sizes to prevent fish from leading from one mesh size to the next mesh size in the gillnet gang. All gillnets were 91.44 meters in length and 3.66 meters in depth (the distance between the float line and lead line of the nets) and were set on the lake bottom.

Of the 157 gang sets fished in the study, 138 were set in the early morning or, occasionally in the late afternoon and lifted slightly earlier on the following day with an average set duration of 22.84 hours (95% CI = $\pm$ 0.42 hours). There were 19 gillnet gangs fished which had more than one overnight fishing period with an average set duration of 55.36 hours (95% CI = $\pm$ 7.83 hours). The 19 longer set durations occurred at Jones Point, Lonely Bay and Slave Point in 1997 and 1998 and at Paulette Bay in 1997 (Appendix 1).

Upon lifting of the nets, all fish were identified to species and the lake whitefish were weighed whole (round weight) to the nearest 5 grams and measured for fork length to the nearest mm. Whitefish were then dressed (gills and internal organs removed) and weighed (dressed weight) to the nearest 5 grams, assigned a maturity status based on visual examination of the gonads and gonads weighed to the nearest gram. Scales and otoliths were removed from all lake whitefish caught, for the purpose of aging. Gonad weights, maturity status and aging structures were collected for use in the development of a model for predicting short and long term effects of mesh size and quota changes on the stock status of Great Slave Lake lake whitefish. This modeling exercise will be reported elsewhere.

Experimental Design and Analysis

A three way factorial analysis of variance model was used to partition the variance of gillnet catches so that effects other than mesh size could be removed to more clearly assess the effect of mesh size on the two fishing efficiency variables. The first fishing efficiency variable is defined as the total round weight of all whitefish caught per net lift and is referred to hereafter as 'total round weight'. The second fishing efficiency variable was defined as the value in Canadian Dollars of the total dressed weight of all whitefish caught per net lift and is

referred to hereafter as 'total value'. Total value efficiency is a product of both total round weight harvested per unit of effort and the per weight value of those fish harvested, with value being a product of both weight lost due to dressing and market size composition of the harvest.

The dressed weight of each whitefish caught was multiplied by the price paid to fishers per kilogram for the respective market size of that fish. The values of all whitefish caught per net lift were then summed to produce the dependent variable 'total value'. Due to logistic restraints, not all whitefish caught could be dressed and weighed. For these fish, an unbiased estimate of dressed weight was calculated by subtracting the mean dressing wastage for the combination of year, location and mesh size within which the fish was caught from the round weight of the undressed fish.

Dressing wastage is the percentage weight loss associated with cleaning the gills and internal organs out of whitefish before they are delivered to fish plants on the lake. Commercial market size, in addition to dressing wastage, was also used to calculate total value efficiency. Fishers are paid different amounts for fish of different market sizes. Market sizes are assigned with respect to the dressed weight of whitefish which are sorted into these size categories after they are delivered to the fish plants.

Market sizes are defined by the Fresh Water Fish Marketing Corporation as Jumbo (greater than 4 pounds or 1.816 kgs), Large (between 3 and 4 pounds or 1.362 and 1.816 kgs), Medium (between 1 ½ and 3 pounds or .681 and 1.362 kgs.), Small (between 1 and 1 ½ pounds or .454 and .681 kgs) and No Market (less than 1 pound or .454 kgs). At present, the prices fishers are paid for market size categories of Great Slave Lake whitefish are: Jumbo – $ 2.48/kg, Large - $ 1.78/kg, Medium - $ 1.54/kg, and Small $ - 0.99/kg. The Freshwater Fish Marketing Corporation does not purchase No Market sized whitefish from Great Slave Lake fishers. Fish of this size are often culled on the lake or less frequently, sold through local markets. No Market sized whitefish are rarely caught in 127 and 133 mm mesh nets. In this study, No Market sized whitefish accounted for only 0.3% and 0.6% of the total dressed weight of all market sizes caught by the 127 and 133 mm mesh sizes respectively.

Experimental cells were a given mesh size set at a given location within a given year (n = 84). Experimental units, or replicates within each experimental cell, are referred to as net lifts in the text of this report and represent the catch in a single net of given mesh size set and lifted at a given location within a given year (n = 741). The number of experimental units was unbalanced amongst experimental cells (Table 2) because some mesh sizes, usually the 127 mm (5 inch), 133 mm (5 ¼ inch) and 139 mm (5 ½ inch), were fished in absence of other mesh sizes to increase sample sizes for any particular year by location combination where catches were extremely low in these larger meshes (Appendix 1). Similarily, a greater number of nets of all mesh sizes were frequently fished at locations where fishing success was relatively low.

SAS (Statistical Analytical Systems) software was used for all analyses and graphics presented in this report (SAS User's Guide: Basics 1985, SAS User's Guide: Statistics 1985 and SAS System for Linear Models 1986). The main effects of the statistical analysis model were sampling year, sampling location and mesh size. Graphs of the response of total round weight and total value were presented only for those main effects and interactions which were significant at $p \leq 0.05$. Three way interaction between the effects of year, location and mesh size on total value and total round weight are not presented graphically in this report but least squares means of total round weight and value per net lift were calculated and are presented in table form for all combinations of year, location and mesh. Contingency tables of pair wise t tests are presented for all significant main effects and their interactions for total value and total round weight except for the three way interaction of year by location by mesh size.

The SAS General Linear Model (GLM) procedure was used for all three way factorial analyses of variance because replicate size (experimental units) was unbalanced amongst experimental cells (table 2). The GLM procedure uses the method of least squares to fit general linear models.. Type III sums of squares were used for all analyses of variance because the statistical model used had interactions which were significant. The principal use for a type III analysis is for situations where main effects (year, location and mesh size in this study) are to be compared even in the presence of interactions (SAS System for Linear Models, 1986).

In addition to the efficiency variables discussed above, the SAS GLM procedure was used to generate least squares means for 1) individual mean round weight and fork length per mesh size and location, 2) mean number of whitefish caught per net lift by mesh size and location and 3) gillnet gang set duration for year, location and mesh size. Pair wise t test comparisons of these parameters were done for specific comparisons among meshes and locations only. Least squares means of these-parameters were presented in table form in the appendix and the results of pair wise t tests of the means were described in text in the results section because this information proved useful for explaining the response of total value and total round weight to the model parameters.

The SAS GLM procedure was also used to test whether or not fishing duration of gillnet gangs varied significantly among years, sampling locations and mesh sizes.

The Shapiro-Wilk test for normality was conducted (SAS UNIVARIATE procedure) to test whether or not the efficiency variables, total round weight and total value per net lift, and the frequency distributions of the variables fork length and round weight for each experimental cell were normally distributed.

The statistical model used for the analysis of each efficiency type, individual round weight, individual fork length, numbers of whitefish caught per net lift and gillnet gang set duration was;

$$Y_{ijkm} = \mu... + \alpha_i + \beta_j + \gamma_k + (\alpha\beta)_{ij} + (\alpha\gamma)_{ik} + (\beta\gamma)_{jk} + (\alpha\beta\gamma)_{ijk} + \varepsilon_{ijkm}$$

where;

Y_{ijkm} = dependent variable mean for year $_i$ location $_j$ and mesh $_k$

$\mu...$ = dependent variable mean for all years, meshes and locations

α_i = dependent variable mean for year $_i$

β_j = dependent variable mean for location $_j$

γ_k = dependent variable mean for mesh $_k$

$(\alpha\beta)_{ij}$ = interaction of year and location

$(\alpha\gamma)_{ik}$ = interaction of year and mesh

$(\beta\gamma)_{jk}$ = interaction of location and mesh

$(\alpha\beta\gamma)_{ijk}$ = interaction of year, location and mesh

ε_{ijkm} = error

Results

Approximately 20,000 fish of various species were caught during the study. Of these, 9239 were lake whitefish. Other species caught were round whitefish, inconnu, walleye, northern pike, lake trout, burbot, longnose sucker and cisco, the majority of which were burbot, longnose sucker and cisco.. Other species caught in this study which are of little or no commercial importance were round whitefish (*Prosopium cylindraceum*, Pallas) and lake cisco (*Coregonus artedii* complex, LeSueur). Only data for lake whitefish, are presented in this report.

Of all lake whitefish caught, 9153 (99.1%) were measured for fork length ,weighed for round weight and had otoliths and scales removed, 7641 (83.5%) were dressed and weighed for dressed weight, 7617 (83.2%) were assigned a sexual maturity status and 7041 (76.9%) had their gonads removed and weighed.

Tests For Normality

A Shapiro-Wilk test indicated that the efficiency variables were normally distributed ($p < 0.0001$) for both total round weight and total value per net lift. The same test indicated that 36 out of 84 of the whitefish fork length frequency distributions and 23 out of 84 of the round weight frequency distributions were not normally distributed (for $p \geq 0.05$). However, residual plots indicated that the model error was normally distributed which indicated that 3 way ANOVA comparisons of fork length and round weight among years, locations and mesh sizes were statistically rigorous.

Fishing Efficiency Analyses

Total Round Weight

Of all main effects and interactions in the model, location had the most significant effect on total round weight of whitefish caught per net lift (Table 3). Three of the sampling locations (Mackenzie Mouth, Pte. de Roch and Slave Point) produced significantly larger catches per unit of effort than other locations (Figure 2a, Appendix 2, Table 4).

Mesh size (Figure 3a, Tables 3 and 5, Appendix 2) and the year by location interaction effects (Figure 4a, Tables 3 and 6, Appendix 2) also had significant effects but their influence was secondary in comparison to the effect of location. Year by mesh (Figure 5a, Tables 3 and 7, Appendix 2) and location by mesh (Figure 6, Table 3, Appendix 2) interaction effects were also significant but their influence on total round weight of whitefish caught per net lift was relatively small. Year and the year by location by mesh interaction did not significantly effect total round weight (Table 3, Appendix 2).

All but 3 of the 15 possible pair wise comparisons of total round weight by mesh size were significant (Table 5). This observation, Figure 3a, and Appendix 2 indicated that mesh size had a highly predictable effect on fishing efficiency expressed as total round weight caught per net lift.

The mean total round weight of whitefish caught per net lift was 15.54 and 10.66 kgs for the 127 and 133 meshes respectively which equaled a 45.8% mean increase in efficiency for mesh reduction from 133 to 127 mm.

Total Value

Of all main effects and interactions in the model, location had the most significant effect on total value of whitefish caught per net lift (Figure 2b, Tables 8 and 9, Appendix 3). Three of the sampling locations (Mackenzie Mouth, Pte. de Roch and Slave Point) produced whitefish catches of relatively high value per unit of effort (Figure 2b, Appendix 3) and were significantly higher than other locations (Table 9).

The year by location interaction (Figure 4b, Tables 8 and 10, Appendix 3) had a significant effect but its influence was secondary in comparison to the effect of location. Mesh (Figure 3b, Tables 8 and 11, Appendix 3) and the year by mesh interaction (Figure 5b, Tables 8 and 12, Appendix 3) had significant effects on total value of whitefish caught per net lift. Year, the location by mesh interaction and the year by location by mesh interaction effects did not significantly effect total value (Table 8, Appendix 3).

Seven of the possible 15 pair wise comparisons of total value by mesh size were not significantly different (Table 11). Mesh size had a significant effect on fishing efficiency expressed as total value per net lift although this effect was less than that of the location effect (Figure 3b, Table 8).

The mean total value (Canadian Dollars) of whitefish caught per net lift was $ 15.24 and $ 11.69 for the 127 and 133 meshes respectively which equaled a 30.4% mean increase in fishing efficiency for a mesh reduction from 133 to 127 mm.

Mean Round Weight, Mean Fork Length and Mean Number of Whitefish Caught By Location

Pair wise t test comparisons of least squares means indicated that all locations

were significantly different with respect to individual mean round weight with most probabilty values being ≤ .0001 except for the comparison of Paulette Bay and Long Island ($p \leq 0.106$). Pair wise t test comparisons of least squares means of individual fork length indicated that all locations were significantly different, with most probability values being ≤ .0001. Least squares means of numbers of whitefish caught per net lift were significantly different among locations for 15 of the 21 possible pair wise t test comparisons, with most probabilities being ≤ .0001. These results indicated that the variance in whitefish size and abundance amongst sampling locations was significant and pronounced, especially with regards to whitefish size distribution.

Least squares means by location, of individual round weights (kgs.) and fork lengths (mm) of whitefish caught and numbers of whitefish caught per net lift are presented in Appendix 4.

Mean Round Weight, Mean Fork Length and Mean Number of Whitefish Caught By Mesh Size

Pair wise t test comparisons of least squares means indicated that the 127 and 133 mm mesh nets were significantly different ($p \leq 0.021$) with respect to mean individual round weight, not significantly different ($p \leq 0.16$) with respect to mean individual fork length and significantly different with respect to mean number of whitefish caught per net lift ($p \leq 0.0001$). These results indicated that these mesh sizes were highly selective for fish round weight but not for fish fork length and that the smaller mesh caught significantly greater numbers of whitefish per net lift.

Least squares means by mesh size, of individual round weights and fork lengths of whitefish caught and numbers of whitefish caught per net lift are presented in Appendix 5.

Fishing Duration of Gillnet Gangs

The fishing duration of gillnet gangs varied significantly among sampling locations ($p \leq .0001$, $F = 27.21$) and years ($p \leq .0001$, $F = 27.47$). The year by location interaction had a significant effect on gillnet gang fishing duration ($p \leq .0001$, $F = 8.24$). No other parameters of the model varied significantly with fishing duration. Of particular relevance to this study was that gillnet gang fishing duration did not vary significantly among mesh sizes ($p < 0.9783$, $F = 0.16$) which indicated that inter-mesh comparisons were not confounded by fishing duration.

Pair wise t test comparisons of least squares means indicated that gillnet gang fishing duration for 1997 (29.67 hours, 95% CI = ± 1.31 hours) was significantly longer than the 1998 mean (24.85 hours, 95% CI = ± 1.30 hours) ($p \leq .0001$). Slave Point (40.68 hours, 95% CI = ± 2.58 hours) and Paulette Bay (31.26 hours, 95% CI = ± 2.37 hours) fishing duration means were significantly different from each other and from all other locations with most probability values being ≤ .0001. Jones Point (25.93 hours, 95% CI = ± 1.90 hours) and Lonely Bay (25.70 hours, 95% CI = ± 2.14 hours) fishing duration means were not significantly different ($p \leq .8720$) but were significantly different from all other locations except for Long Island (23.08 hours, 95% CI = ± 2.68 hours) (Jones Point comparison - $p < .0837$, Lonely Bay comparison – $p < .1277$) with most probability values being ≤ .0001. Least squarews means of gillnet gang fishing duration were 21.37 hours (95% CI = ± 3.08 hours) for the Mackenzie Mouth and 22.81 hours (95% CI = ± 2.14 hours) for Pte. de Roche.

Discussion

Mesh Reduction and Fishing Efficiency

The effects of sampling year, sampling location and mesh size on fishing efficiency was very similar for both types of efficiency examined, total value and total round weight caught per net lift. This similarity is expected because total value efficiency was derived, in part, from total round weight efficiency.

The most efficient mesh sizes to fish with in this study, in terms of total round weight of all whitefish caught per unit of effort, were 89 mm (3 ½ inch) and 121 mm (4 ¾ inch). The least productive meshes

were 133 mm (5 ¼ inch) and 139 mm (5 ½ inch) (Figure 3a, Table 5, Appendix 2).

The most efficient mesh size to fish with in terms of total value of whitefish caught per unit of effort, was the 121 mm (4 ¾ inch) mesh. The 89 mm (3 ½ inch), 114 mm (4 ½ inch) and 127 mm (5 inch) meshes had very similar efficiencies but were much less efficient than the 121 mm mesh. The least efficient meshes were 133 mm (5 ¼ inch) and 139 mm (5 ½ inch) (Figure 3b, Appendix 3).

Although the response of total value and total weight to year, location, and mesh size were very similar some differences were noted. Total round weight efficiency was highest for the Mackenzie Mouth sampling location but total value efficiency was highest for the Pte. de Roche location. Although whitefish were smaller on average at Pte. de Roche than at Mackenzie Mouth, the catches at Mackenzie Mouth were very low in 1997 (Figure 4). This reduced the overall mean total value per net lift for Mackenzie Mouth to a value lower than that observed for Pte. de Roche. Total round weight efficiency was highest for the 89 mm mesh but total value efficiency was highest for the 121 mm mesh (Figure 3). Whitefish caught in the 89 mm mesh were of smaller market sizes and, therefore, were of less value per kg even though their total round weight exceeded that of whitefish caught in the 121 mm mesh.

Explanation of Mesh Performance

Two explanations are postulated for the significantly greater observed fishing efficiency of the 127 mm mesh compared to the 133 mm mesh. Firstly, large differences in the distribution of whitefish biomass between those size classes most vulnerable to the 127 mm mesh and those most vulnerable to the 133 mm mesh coupled with a highly selective gear, may have caused the relatively large difference in fishing efficiency between these two meshes. Gillnets are very selective (Hamley 1975). Baranov (1948) states that as a rule of thumb, few fish are caught whose length differ from the optimum by more than 20%. Lake whitefish are no exception to this rule as demonstrated by several studies (McCombie and Fry 1960, Berst 1961, McCombie 1961, Regier and Robson 1966, McCombie and Berst 1969, Bell et al. 1977, and Spangler and Collins 1992).

Healey (1975) suggests that biomass does in fact vary greatly amongst the largest size classes of whitefish found in the extreme right hand side of the theoretical size distribution of Great Slave Lake lake whitefish. This characteristic of the size distribution of Great Slave Lake lake whitefish is well demonstrated by the following estimates. For a 139 mm (5 ½ inch) mesh fishery on Great Slave Lake, Healey estimated that only 0.252% of whitefish production and 1.17% of the whitefish biomass would be available to the fishery. For a 114 mm (4 ½ inch) mesh fishery, he estimated that 1.337% of whitefish production and 4.14% of whitefish biomass would be available to the fishery.

Healey's estimate that there would be 3.5 times more biomass available to the fishery when mesh size was reduced by 25 mm is consistent with the findings of this study, that CPUE or mean total round weight per net lift (an index of biomass available to the fishery) was increased 45.8% by a 6 mm reduction in mesh size. Healey's estimates, therefore support the argument that in this study the 127 mm mesh was significantly more efficient than the 133 mm mesh because the 127 mm mesh was selective for a more abundant size class than was the 133 mm mesh.

The second postulated explanation for differences in fishing efficiency observed between the 127 and 133 mm meshes is that these meshes may capture whitefish of the same size class and abundance but with different efficiency in regards to the ability of fish to escape after net encounter. These meshes do not differ in regards to size selectivity as demonstrated by forklengths of lake whitefish which were not significantly different between the 127 and 133 mm meshes and although round weights of captured lake whitefish were significantly different, the difference was small (Appendix 5). It follows then that escapement after net encounter alone may underlie observed fishing efficiency differences in these meshes more so than the interplay of

biomass distribution and gear selectivity as suggested by Healey for two nets with a relatively large disparity in mesh size of 25 mm (1 inch). Whereas in this study, there was only 6 mm (1/4 inch) difference between the two meshes in question. Yet the 127 mm mesh was significantly more efficient (45.8% for total round weight per net lift). The conclusion of the second postulate is that size class biomass or abundance and gillnet size selectivity have little or no influence on differences in fishing efficiency of the 127 and 133 mm meshes.

An explanation for the greater ability of the 127 mm mesh to capture and retain lake whitefish after net encounter is evident in data published by Moshenko and Low (1978). They presented ratios of maximum lake whitefish girth to mesh perimeter girth for various gillnet mesh sizes fished on Great Slave Lake. The 127 mm mesh had a higher proportion of ratios greater than 1 than did the 133 mm mesh nets. This indicates that whitefish which were just able to pass through the 133 mm mesh and remain uncaptured would be captured by the 127 mm mesh net. The assumption underlying the above explanation is that the relative proportion of lake whitefish in Great Slave Lake, which are of a size which would not allow passage through the 133 mm mesh net, is extremely small. This assumption is supported by the results of this study since sizes of whitefish increased steadily from 89 to 121 mm in mesh size, then remained almost unchanged for mesh sizes 127, 133 and 139 mm (Appendix 5). Undoubtedly, there would be a more pronounced difference in the size selectivity of these meshes if the fished population contained a significant proportion of whitefish of sizes which were vulnerable to girthing by the 133 mm mesh, but the relative abundance of these larger sized whitefish is very low. In short, both the 127 and 133 mm meshes exploit the same size component of the whitefish population, the extreme right hand tail of the size distribution, but the 127 mm mesh net is more efficient because it girths significantly more fish which would be otherwise able to pass through the 133 mm mesh net.

Mesh Reduction and Sustainability

Cushing (1973) describes two types of overfishing, growth overfishing and recruitment overfishing. Mesh reduction will probably not result in a lowering of the optimum sustainable yield of Great Slave Lake lake whitefish by catching fish prior to them having a chance to grow (growth overfishing) because most of the somatic growth of whitefish caught in the 127 mm mesh has already occurred. Lake whitefish stocks have demonstrated a marked stability with regards to size and age composition of the harvest since 1977 when the legal commercial mesh size was reduced from 139 mm to 133 mm and the reduced mesh size of 127 mm exploits the same size classes as does the traditional mesh size of 133 mm. The similarity in size selectivity of these meshes is evident in the results of other Great Slave Lake studies (Roberge et al. 1985, Moshenko and Low 1978). Furthermore, Healey's modeling suggests that a 127 mm mesh gillnet fishery will exploit an extremely small proportion of the standing stock which, in turn, suggests that this mesh size will have very little impact on sustainability of the fishery as did the 133 mm mesh, if present lake quotas remain unchanged.

Cushing states that recruitment overfishing occurs when fish are caught faster than the population's intrinsic ability to replace itself. As with growth overfishing, recruitment overfishing will also not likely occur due to a mesh reduction to 127 mm because the same size classes or components of the mature spawning stock are exploited by both the 127 and 133 mm meshes. Also, recruitment overfishing is not likely a threat to the sustainability of Great Slave Lake lake whitefish stocks or subpopulations because they mature at sizes which are much smaller than the mean sizes of lake whitefish captured in the largest 5 mesh sizes used in this study. Kennedy (1952) states that between 80 to 100% of Great Slave Lake lake whitefish are mature at sizes $\geq$ 0.822 kgs.. Roberge et al. (1985) reported Great Slave Lake lake whitefish sizes at maturity which were similar to those found by Kennedy. In this study, mean lake whitefish sizes ranged from 0.967 to 1.208 kgs. for all meshes

except for the 89 mm mesh (Appendix 5). This implies that almost all whitefish captured in all meshes in this study were mature.

Recruitment overfishing could occur if, for example, a large proportion of mature fish were consistently harvested from a given stock in consecutive fishing seasons. In this scenario, fishing pressure would not be proportional to stock sizes. The management areas of Great Slave Lake were created to distribute fishing pressure evenly throughout the lake. In summary, at present quotas and if harvests from individual stocks are proportional to the abundances of these lake whitefish stocks, mesh reduction to 127 mm is unlikely to result in recruitment overfishing of Great Slave Lake lake whitefish.

Location and Fishing Efficiency

Location had the most significant effect on both total value and total round weight of whitefish caught per net lift and exceeded the effects of mesh size and year on these two variables. This result is expected because of the large size of the lake and the diversity of fish habitats, limnological conditions and bottom fauna that it contains as described by Rawson 1950, 1953a and 1953b. Consequently, where fish were relatively abundant and large, fishing efficiency was high (Mackenzie Mouth, Pte. de Roche and Slave Point) Similarly, where fish where not abundant and where fish were relatively small, fishing efficiency was relatively low (Lonely Bay, Jones Point, Long Island and Paulette Bay) (Figures 2 and 4, Appendix 4). That size distributions and abundances of whitefish vary throughout the lake, is evident in the large amount of variance observed among size distributions of genetically discrete samples of whitefish collected throughout the lake (Day, unpublished data), between location differences in size and CPUE of commercially harvested whitefish presented in previous studies (Keleher 1972), between location differences in size and CPUE of experimentally sampled whitefish presented in previous studies (Roberge et al. 1985, Moshenko and Low 1978, Bond 1975 and Bond and Turnbull 1973) and significant differences in mean fork length and round weight and CPUE observed amongst the sampling locations of this study (Appendix 4, Figures 2 and 4).

The sedentary nature of Great Slave Lake whitefish is well documented and suggests that the same fish of the same stocks or subpopulations were not vulnerable to capture at all sampling locations. Keleher (1963) found that lake whitefish tagged at 12 locations on Great Slave Lake had mean net movements from point of tagging to point of recapture which ranged between 0.8 and 38.3 miles amongst the tagging locations and that two thirds of tagged fish of all species were recaptured within 10 miles of their initial tagging location. Similarily, Day (unpublished data) found that Great Slave Lake lake whitefish collected from spawning aggregations and tagged, were recaptured within 40 km of their initial point of tagging. The movement of Great Slave Lake whitefish during each year of the study when sampling occurred (late June to late August) is expected to be even less than movements reported from tagging studies because the periods during which tagged whitefish were recovered in these studies encompassed several years.

Total value and total weight per net lift appeared to be positively correlated with varying levels of commercial fishing intensity which sampling locations had experienced. Fishing intensity was defined, out of necessity, as the proportion of the annual management area commercial quota which had traditionally been harvested. It was not defined by the relationship between whitefish abundance and harvest because whitefish abundances in Great Slave Lake are unknown. Locations in management area I West which has experienced high commercial fishing intensity, also had the highest fishing efficiencies. Paulette Bay in management area III which has experienced a low fishing intensity, had low fishing efficiency. Locations in management area II which has experienced moderate fishing intensity, had moderate fishing efficiencies.

Set Duration and Fishing Efficiency

The fishing efficiency variables, total value and round weight per net lift, could not be standardized to a single fishing duration

prior to their analysis for the following reasons. Dividing catch by set duration, a simple method of standardizing the efficiency variables to a given unit of time (eg. 24 hours), was not done prior to analysis because the relationship between catch and set duration is not linear. This relationship is usually exponential, with catches decreasing and becoming asymptotic as the nets saturate with fish (Hamley 1975). Furthermore, this relationship likely varied amongst study years and locations. Standardization of gill net CPUE data to a unit of time can be done via regression analysis if there is a wide enough range of data points occurring along both the x and y axes to allow for the calculation of a reliable and predictive regression equation. However, it was not attempted in this study because 3 of the 6 locations (in 1997 and 1998) and 1 of the 6 locations (in 1998) had relatively little variance in set duration (Appendix 1) which would invalidate the use of regression analysis for these locations. For locations where there was significant variance in set duration, regression analysis would also not be valid because data would be tightly clustered above the x axis (set duration) of the regression at 2 points only, 24 and 48 hours (Appendix 1).

Gillnet gang fishing duration was not evenly distributed amongst sampling locations and years and could confound inter-location and inter-year comparisons presented in this report. However, total value and total round weight of whitefish caught per net lift was not positively correlated with gillnet gang fishing duration, as would be predicted, with longer durations resulting in greater catches. For example, Jones Point, Lonely Bay and Paulette Bay had some set durations which were greater than one overnight period (Appendix 1) but their mean total values and total round weights per net lift were among the lowest observed in the study (Figure 2). Although Slave Point had the longest mean gillnet gang fishing duration, it did not have the largest mean total whitefish round weight per net lift (Figure 2). These observations suggest that the unbalanced distribution of gillnet gang fishing duration among sampling locations and years had a very marginal effect on mean total values and round weights observed in comparison to the effects that sampling years and locations had on these variables. Only 19 of the 157 gillnet gang lifts (12.1%) had atypically long set durations which included more than one overnight period (Appendix 1). Therefore, the observations of total whitefish value and total round weight for sampling locations and years presented in this report probably closely represent what they would have actually been if set durations longer than one overnight period had not occurred. Furthermore, the study's primary objective was to compare the effect of mesh size on fishing efficiency and fishing duration was not significantly different among mesh sizes.

Gillnet Selectivity

In the scientific literature on gillnet selectivity, gillnet efficiency and gillnet selectivity have specific definitions and are not synonymous terms. Lagler (1968) in Hamley (1975) defines size selectivity of gear as a curve giving for each size of fish the proportion of the total population of that size which is caught and retained by a unit operation of the gear. Hamely (1975) states that efficiency of a net is the area under its selectivity curve and the expected number of fish caught by a net is proportional to its efficiency, if all size classes of fish in the population are of equal abundance. Efficiency is defined in this study simply as CPUE (catch and value per net lift) and was generally lower for the larger meshes. In summary and in contrast to the definition of gillnet efficiency in the scientific literature, CPUE and efficiency are terms used synonymously in this study and were not calculated with assumptions on the underlying abundances of size classes in the fished population.

Summary

The fishing efficiencies of 6 different mesh sizes were assessed in a rigorous quantitative manner that allowed much of the variance associated with gillnet catches to be removed for the specific examination of the effect of mesh size alone on fishing efficiency (objective 1). Mesh reduction from 133 mm to 127 mm, was found to increase the average total round weight of whitefish harvested per unit of effort of the

commercial fishery by 45.8% and the average total value of whitefish harvested per unit of effort by 30.4% .

Sustainability of this fishery is predicted to not be adversely effected by mesh reduction because both the 127 and 133 mm mesh nets exploited the same size classes of whitefish, but the 127 mm mesh net was more efficient because it retained more whitefish after net encounter. Furthermore, the 127 mm mesh net exploits an extremely small proportion of the standing stock of Great Slave Lake whitefish (objective 2).There are risks to sustainability associated with mesh reduction and further reduction is not advised at this point in time until modeling analyses of whitefish abundance and production parameters are completed.

Fishers should note that increases in efficiency associated with a very small reduction in mesh size (6 mm) can not be expected at all locations and times when they fish because these percentages were means for all locations and years and location had a greater effect on fishing efficiency than did mesh size. Also, the 30.4% value increase may not necessarily translate into an average of 30.4% increase in profits because profitability involves other factors not examined by this study such as crew salaries, equipment maintenance and purchase, fuel etc., some of which may be fixed costs which are independent of how quickly fishers are able to harvest whitefish. Also, caution is advised when extrapolating findings of the study to lake management areas which were not assessed (Areas I East, IV and V).

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Literature Cited

Baranov, F.I. 1948. Theory and assessment of fishing gear. Pishchepromizdat, Moscow. (Ch. 7 Theory of fishing with gillnets transl. Translated from Russian by Ont. Dep. Lands For., Maple Ont., 45 p.)

Bell, G., P. Handford, and C. Dietz. 1977. Dynamics of an exploited population of lake whitefish (*Coregonus clupeaformis*). J. Fish. Res. Board Can. 34: 942-953.

Berst, A.H. 1961. Selectivity and efficiency of experimental gillnets in South Bay and Georgian Bay of Lake Huron. Trans. Am. Fish. Soc. 90: 412-418.

Bond, W.A. and T.D. Turnbull. 1973. Fishery investigations on Great Slave Lake, Northwest Territories 1972. Can. Fish. Mar. Serv. Tech. Rep. Ser. CEN/T-73-7: 78 p.

Bond, W.A. 1975. Results of an experimental gillnetting program at the west end of Great Slave Lake, N.W.T. during summer, 1974. Can. Fish. Mar. Serv. Tech. Rep. Ser. CEN/D-75-7: 83 p.

Cushing, D.H. 1973. Dependence of recruitment on parent stock. J. Fish. Res. Board Can. 30: 1965-1976.

Day, A.C., and G. Low. 1992. The Great Slave Lake commercial lake whitefish, *Coregonus clupeaformis*, fishery. Arctic Fisheries Science Advisory Committee Background Document 1991/92-08, Winnipeg. i + 32 p.

Day, A.C., G. Low, and J.B. Dunn. 1995. Genetic stock delineation of Great Slave Lake lake whitefish , *Coregonus clupeaformis* (Mitchill), by electrophoretic assessment of dehydrogenase enzymes and hemoglobin genotypes. Arctic Fisheries Science Advisory Committee Background Document No. 1994/95-07, Winnipeg. i + 33 p.

Department of Fisheries and Oceans. 1999. Annual summary of fish and marine mammal harvest data for the Northwest Territories, Volume 9, 1996-1997: xii + 772 p.

Hamley, J.M. 1975. Review of gillnet selectivtiy. J. Fish. Res. Board Can. 32(11): 1943-1969.

Healey, M.C. 1975. Dynamics of exploited whitefish populations and their management with special reference to the Northwest Territories. J. Fish. Res. Board Can. 32: 427-448.

Keleher, J.J. 1963. The movement of tagged Great Slave Lake fish. J. Fish. Res. Board Can. 20(2): 319-326.

Keleher, J.J. 1972. Great Slave Lake: Effects of exploitation on the salmonid community. J. Fish. Res. Board Can. 29(7): 41-753.

Kennedy, W.A. 1952. Growth, maturity, fecundity and mortality in the relatively unexploited whitefish, *Coregonus clupeaformis*, of Great Slave Lake. J. Fish. Res. Board Can. 10(7): 413-441.

Kennedy, W.A. 1956. The first ten years of commercial fishing on Great Slave Lake. Bull. Fish. Res. Board Can. 107: 58 p.

Lagler, K.F. 1968. Capture, sampling and examination of fishes. *In* W.E. Ricker (ed.) Methods for assessment of fish production in fresh waters, p. 7-45. IBP Handbook 3. Blackwell Sci. Publ., Oxford and Edinburgh. 313 p.

McCombie, A.M. 1961. Gill-net selectivity of lake whitefish from the Goderich-Bayfield area, Lake Huron. Trans. Am. Fish. Soc. 90: 337-340.

McCombie, A.M. and A.H. Berst. 1969. Some effects of shape and structure of fish on selectivity of gillnets. J. Fish. Res. Board Can. 26: 2681-2689.

McCombie, A.M. and F.E.J. Fry. 1960. Selectivity of gillnets for lake whitefish, *Coregonus clupeaformis*. Trans. Am. Fish. Soc. 89: 176-184.

Moshenko, R.W. and G. Low. 1978. An experimental gillnetting program on Great Slave Lake, Northwest Territories, 1977. Can. Fish. Mar. Serv. Data Rep. 102: vi + 51 p.

Moshenko, R.W., L.W. Dahlke, and G. Low. 1978. Data from the commercial fishery for lake whitefish, *Coregonus clupeaformis* (Mitchill),from the commercial fishery on Great Slave Lake, Northwest Territories, 1977. Can. Fish. Mar. Serv. Data Rep. 101: v + 30 p.

Moshenko, R.W. and D.V. Gillman. 1978.Creel census and biological investigation on lake trout, *Salvelinus namaycush* (Walbaum), from Great Bear and Great Slave lakes, Northwest Territories, 1975-76. Can. Fish. Mar. Serv. Manuscr. Rep. 1440: v + 37 p.

Rawson, D.S. 1950. The physical limnology of Great Slave Lake. J. Fish. Res. Board Can. 8: 1-166.

Rawson, D.S. 1951. Studies of fish of Great Slave Lake. J. Fish. Res. Board Can. 8: 207-240.

Rawson, D.S. 1953a. The standing crop of plankton in lakes. J. Fish. Res. Board Can. 10: 224-237.

Rawson, D.S. 1953b. The bottom fauna of Great Slave Lake. J. Fish. Res. Board Can. 10: 486-520.

Regier, H.A. and D.S. Robson. 1966. Selectivity of gillnets especially to lake whitefish. J. Fish. Res. Board Can. 23(3): 423-454.

Roberge, M.M., G. Low, and C.J. Read. 1985. Data from an experimental gillnetting program on Great Slave Lake, Northwest Territories, 1980-81. Can. Data Rep. Fish. Aquat. Sci. 537: vii + 156 p.

SAS Institute Inc. SAS User's Guide: Basics, Version 5 Edition. Cary, North Carolina: SAS Institute Inc., 1985. 1290 pp.

SAS Institute Inc. SAS User's Guide: Statistics, Version 5 Edition. Cary, North Carolina: SAS Institute Inc., 1985. 956 pp.

SAS Institute Inc. SAS System for Linear Models. 1986 Edition. Cary, North Carolina: SAS Institute Inc., 210 pp.

Spangler, G.R. and J.J. Collins. 1992. Lake Huron fish community structure based on gill-net catches corrected for selectivity and encounter probability. N. Am. J. Fish. Manage. 15: 79-83.

Table 1. Time periods of fishing for multi-mesh gillnet gangs set at 7 sampling locations in 1997 and 1998 on Great Slave Lake.

Location	Year	Fishing Periods
Jones Point	1997	Aug. 9th to Aug. 27th
Lonely Bay	1997	Aug. 14th to Aug. 24th
Long Island	1997	Aug. 19th to Aug. 24th
Mackenzie Mouth	1997	Aug. 3rd to Aug. 5th
Paulette Bay	1997	June 20th to June 24th
Pte. de Roche	1997	July 18th to July 24th
Slave Point	1997	July 27th to Aug. 2nd
Jones Point	1998	Aug. 9th to Aug. 15th
Lonely Bay	1998	Aug. 17th to Aug. 23rd
Long Island	1998	Aug. 25th to Aug. 28th
Mackenzie Mouth	1998	July 15th to July 20th
Paulette Bay	1998	June 17th to June 29th
Pte. de Roche	1998	July 7th to July 12th
Slave Point	1998	July 22nd to July 29th

Table 2. Number of gillnet lifts (experimental units, n = 741) given for each combination of sampling year by stretched measure mesh size (mm) by sampling location on Great Slave Lake. There are 84 experimental cells derived from 2 sampling years by 7 sampling locations by 6 mesh sizes. All nets are 91.44 meters long and 3.66 meters deep.

Year	1997						Total 1997	1998						Total 1998	Total 1997 and 1998
Mesh Size	89 mm	114 mm	121 mm	127 mm	133 mm	139 mm		89 mm	114 mm	112 mm	127 mm	133 mm	139 mm		
Mackenzie Mouth	3	3	3	6	6	6	27	4	4	4	6	6	6	30	57
Pte. de Roche	8	8	8	8	8	8	48	9	9	9	12	12	12	63	111
Slave Point	4	4	4	7	6	7	32	8	8	8	8	8	8	48	80
Jones Point	10	13	10	16	19	18	86	9	9	9	10	11	11	59	145
Lonely Bay	7	7	7	15	15	15	66	7	7	7	11	11	11	54	120
Long Island	6	7	6	23	28	28	98	3	3	3	6	6	6	27	125
Paulette Bay	5	5	5	7	7	7	36	9	9	9	13	13	14	67	103
Total 1997	43	47	43	82	89	89	393								
Total 1998								49	49	49	66	67	68	348	
Total 1997 and 1998	89mm=92	114mm=96	121mm=92	127mm=148	133mm=156	139mm=157									741

Table 3. Three way factorial analysis of variance for the effects of year (1997 and 1998), 6 stretched measure gillnet mesh sizes and 7 sampling locations on the total round weight (kgs) of all whitefish caught per net lift in Great Slave Lake.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	83	52597.7674	633.7080	7.36	<.0001
Error	605	52081.4635	86.0851		
Corrected Total	688	104679.2309			

R-Square	Coeff Var	Root MSE	Mean Total Round Weight (kgs) of All Whitefish Caught per Net Lift
0.502466	68.59242	9.278204	13.52657

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	1	134.37383	134.37383	1.56	0.2120
LOCATION	6	18810.14833	3135.02472	36.42	<.0001
MESH	5	6865.05507	1373.01101	15.95	<.0001
YEAR*LOCATION	6	11183.22982	1863.87164	21.65	<.0001
YEAR*MESH	5	2413.20972	482.64194	5.61	<.0001
LOCATION*MESH	30	4674.59562	155.81985	1.81	0.0056
YEAR*LOCATION*MESH	30	2348.80095	78.29336	0.91	0.6075

Table 4. Probabilities of obtaining a greater t value for t test comparisons between locations. Comparisons are of least squares means of total round weight (kgs) of all whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

i / j	Jones Point	Lonely Bay	Long Island	Mackenzie Mouth	Paulette Bay	Pte. de Roche	Slave Point
Jones Point	*	0.4602	0.4148	<.0001	0.4253	<.0001	<.0001
Lonely Bay	0.4602	*	0.8710	<.0001	0.1575	<.0001	<.0001
Long Island	0.4148	0.8710	*	<.0001	0.1542	<.0001	0.0001
Mackenzie Mouth	<.0001	<.0001	<.0001	*	<.0001	0.0031	<.0001
Paulette Bay	0.4253	0.1575	0.1542	<.0001	*	<.0001	<.0001
Pte. de Roche	<.0001	<.0001	<.0001	0.0031	<.0001	*	0.0058
Slave Point	<.0001	<.0001	0.0001	<.0001	<.0001	0.0058	*

Table 5. Probabilities of obtaining a greater t value for t test comparisons between stretched measure mesh sizes (mm). Comparisons are of least squares means of total round weight (kgs) of all whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

j \ i	89	114	121	127	133	139
89	*	<.0001	0.2567	0.0014	<.0001	<.0001
114	<.0001	*	0.0054	0.2877	0.0121	0.0082
121	0.2567	0.0054	*	0.0493	<.0001	<.0001
127	0.0014	0.2877	0.0493	*	<.0001	<.0001
133	<.0001	0.0121	<.0001	<.0001	*	0.8771
139	<.0001	0.0082	<.0001	<.0001	0.8771	*

Table 6. Probabilities of obtaining a greater t value for t test comparisons amongst combinations of sampling locations and years. Comparisons are of least squares means of total round weight (kgs) of all whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

j \ i	1997 Jones Point	1997 Lonely Bay	1997 Long Island	1997 Mackenzie Mouth	1997 Paulette Bay	1997 Pte.de Roche	1997 Slave Point	1998 Jones Point	1998 Lonely Bay	1998 Long Island	1998 Mackenzie Mouth	1998 Paulette Bay	1998 Pte.de Roche	1998 Slave Point
1997 Jones Point	*	0.0044	0.0513	0.1025	0.5607	<.0001	<.0001	0.6102	0.2697	0.9791	<.0001	0.1741	<.0001	0.0308
1997 Lonely Bay	0.0044	*	0.3726	0.6265	0.0807	0.0011	0.0008	0.0332	0.0004	0.0492	<.0001	0.0002	<.0001	0.6035
1997 Long Island	0.0513	0.3726	*	0.8486	0.3157	<.0001	<.0001	0.1959	0.0059	0.1850	<.0001	0.0030	<.0001	0.7454
1997 Mackenzie Mouth	0.1025	0.6265	0.8486	*	0.3270	0.0025	0.0014	0.2388	0.0196	0.2025	<.0001	0.0119	<.0001	0.9468
1997 Paulette Bay	0.5607	0.0807	0.3157	0.3270	*	<.0001	<.0001	0.8967	0.1496	0.6767	<.0001	0.0985	<.0001	0.2158
1997 Pte. de Roche	<.0001	0.0011	<.0001	0.0025	<.0001	*	0.6055	<.0001	<.0001	<.0001	<.0001	<.0001	0.2652	0.0003
1997 Slave Point	<.0001	0.0008	<.0001	0.0014	<.0001	0.6055	*	<.0001	<.0001	<.0001	<.0001	<.0001	0.6722	0.0002
1998 Jones Point	0.6102	0.0332	0.1959	0.2388	0.8967	<.0001	<.0001	*	0.1412	0.7365	<.0001	0.0885	<.0001	0.1250
1998 Lonely Bay	0.2697	0.0004	0.0059	0.0196	0.1496	<.0001	<.0001	0.1412	*	0.4088	<.0001	0.8031	<.0001	0.0036
1998 Long Island	0.9791	0.0492	0.1850	0.2025	0.6767	<.0001	<.0001	0.7365	0.4088	*	<.0001	0.3073	<.0001	0.1274
1998 Mackenzie Mouth	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	*	<.0001	<.0001	<.0001
1998 Paulette Bay	0.1741	0.0002	0.0030	0.0119	0.0985	<.0001	<.0001	0.0885	0.8031	0.3073	<.0001	*	<.0001	0.0018
1998 Pte. de Roche	<.0001	<.0001	<.0001	<.0001	<.0001	0.2652	0.6722	<.0001	<.0001	<.0001	<.0001	<.0001	*	<.0001
1998 Slave Point	0.0308	0.6035	0.7454	0.9468	0.2158	0.0003	0.0002	0.1250	0.0036	0.1274	<.0001	0.0018	<.0001	*

Table 7. Probabilities of obtaining a greater t value for t test comparisons amongst combinations of stretched measure mesh sizes (mm) and years. Comparisons are of least squares means of total round weight (kgs) of all whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

	i	1997 89 mm	1997 114 mm	1997 121 mm	1997 127 mm	1997 133 mm	1997 139 mm	1998 89 mm	1998 114 mm	1998 121 mm	1998 127 mm	1998 133 mm	1998 139 mm
j													
1997 - 89 mm		*	0.0545	0.0200	0.8448	0.0083	0.0312	<.0001	0.7131	0.9355	0.9564	0.0126	0.0018
1997 - 114 mm		0.0545	*	<.0001	0.0461	0.6091	0.9955	<.0001	0.0180	0.0577	0.0424	0.6283	0.2522
1997 - 121 mm		0.0200	<.0001	*	0.0045	<.0001	<.0001	0.1253	0.0412	0.0133	0.0101	<.0001	<.0001
1997 - 127 mm		0.8448	0.0461	0.0045	*	0.0038	0.0200	<.0001	0.5308	0.9120	0.8780	0.0073	0.0007
1997 - 133 mm		0.0083	0.6091	<.0001	0.0038	*	0.5565	<.0001	0.0015	0.0082	0.0042	0.9982	0.4501
1997 - 139 mm		0.0312	0.9955	<.0001	0.0200	0.5565	*	<.0001	0.0075	0.0320	0.0199	0.5849	0.1947
1998 - 89 mm		<.0001	<.0001	0.1253	<.0001	<.0001	<.0001	*	0.0002	<.0001	<.0001	<.0001	<.0001
1998 - 114 mm		0.7131	0.0180	0.0412	0.5308	0.0015	0.0075	0.0002	*	0.6434	0.6475	0.0028	0.0003
1998 - 121 mm		0.9355	0.0577	0.0133	0.9120	0.0082	0.0320	<.0001	0.6434	*	0.9750	0.0127	0.0017
1998 - 127 mm		0.9564	0.0424	0.0101	0.8780	0.0042	0.0199	<.0001	0.6475	0.9750	*	0.0075	0.0008
1998 - 133 mm		0.0126	0.6283	<.0001	0.0073	0.9982	0.5849	<.0001	0.0028	0.0127	0.0075	*	0.4806
1998 - 139 mm		0.0018	0.2522	<.0001	0.0007	0.4501	0.1947	<.0001	0.0003	0.0017	0.0008	0.4806	*

Table 8. Three way factorial analysis of variance for the effects of year (1997 and 1998), 6 stretched measure gillnet mesh sizes and 7 sampling locations on the total value (Canadian Dollars) of all market sizes of dressed whitefish caught per net lift in Great Slave Lake.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	83	37416.67607	450.80333	5.38	<.0001
Error	598	50079.38315	83.74479		
Corrected Total	681	87496.05922			

R-Square	Coeff Var	Root MSE	Mean Total Value (Canadian Dollars) of All Market Sizes of Dressed Whitefish Caught Per Net Lift
0.427638	66.06799	9.151218	13.85121

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	1	275.04469	275.04469	3.28	0.0704
LOCATION	6	13194.53092	2199.08849	26.26	<.0001
MESH	5	2689.78207	537.95641	6.42	<.0001
YEAR*LOCATION	6	6446.63781	1074.43964	12.83	<.0001
YEAR*MESH	5	1200.75660	240.15132	2.87	0.0144
LOCATION*MESH	30	3590.54551	119.68485	1.43	0.0666
YEAR*LOCATION*MESH	30	3583.93367	119.46446	1.43	0.0676

Table 9. Probabilities of obtaining a greater t value for t test comparisons between Locations. Comparisons are of least squares means of total value (Canadian Dollars) of all market sizes of all dressed whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

i / j	Jones Point	Lonely Bay	Long Island	Mackenzie Mouth	Paulette Bay	Pte. de Roche	Slave Point
Jones Point	*	0.8500	0.9229	<.0001	0.1317	<.0001	0.0092
Lonely Bay	0.8500	*	0.8005	<.0001	0.2001	<.0001	0.0076
Long Island	0.9229	0.8005	*	<.0001	0.1645	<.0001	0.0250
Mackenzie Mouth	<.0001	<.0001	<.0001	*	<.0001	0.2643	0.0069
Paulette Bay	0.1317	0.2001	0.1645	<.0001	*	<.0001	0.0003
Pte. de Roche	<.0001	<.0001	<.0001	0.2643	<.0001	*	<.0001
Slave Point	0.0092	0.0076	0.0250	0.0069	0.0003	<.0001	*

Table 10. Probabilities of obtaining a greater t value for t test comparisons amongst combinations of sampling locations and years. Comparisons are of least squares means of total value (Canadian Dollars) of all market sizes of all dressed whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

i / j	1997 Jones Point	1997 Lonely Bay	1997 Long Island	1997 Mackenzie Mouth	1997 Paulette Bay	1997 Pte.de Roche	1997 Slave Point	1998 Jones Point	1998 Lonely Bay	1998 Long Island	1998 Mackenzie Mouth	1998 Paulette Bay	1998 Pte.de Roche	1998 Slave Point
1997 Jones Point	*	0.1315	0.0395	0.2285	0.8074	0.0015	0.2815	0.9185	0.0787	0.1562	<.0001	0.0337	<.0001	0.0022
1997 Lonely Bay	0.1315	*	0.6197	0.8248	0.1471	0.0975	0.9295	0.1398	0.0029	0.0155	<.0001	0.0010	<.0001	0.1219
1997 Long Island	0.0395	0.6197	*	0.9143	0.0591	0.2279	0.8071	0.0481	0.0005	0.0051	<.0001	0.0002	<.0001	0.2739
1997 Mackenzie Mouth	0.2285	0.8248	0.9143	*	0.2088	0.3558	0.9140	0.2211	0.0219	0.0393	<.0001	0.0111	<.0001	0.3967
1997 Paulette Bay	0.8074	0.1471	0.0591	0.2088	*	0.0046	0.2537	0.8846	0.2163	0.2848	<.0001	0.1203	<.0001	0.0062
1997 Pte. de Roche	0.0015	0.0975	0.2279	0.3558	0.0046	*	0.2879	0.0025	<.0001	0.0003	<.0001	<.0001	<.0001	0.9158
1997 Slave Point	0.2815	0.9295	0.8071	0.9140	0.2537	0.2879	*	0.2709	0.0292	0.0501	<.0001	0.0151	<.0001	0.3239
1998 Jones Point	0.9185	0.1398	0.0481	0.2211	0.8846	0.0025	0.2709	*	0.1238	0.2010	<.0001	0.0595	<.0001	0.0036
1998 Lonely Bay	0.0787	0.0029	0.0005	0.0219	0.2163	<.0001	0.0292	0.1238	*	0.9679	<.0001	0.7187	<.0001	<.0001
1998 Long Island	0.1562	0.0155	0.0051	0.0393	0.2848	0.0003	0.0501	0.2010	0.9679	*	<.0001	0.7985	<.0001	0.0004
1998 Mackenzie Mouth	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	*	<.0001	0.5271	<.0001
1998 Paulette Bay	0.0337	0.0010	0.0002	0.0111	0.1203	<.0001	0.0151	0.0595	0.7187	0.7985	<.0001	*	<.0001	<.0001
1998 Pte. de Roche	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.5271	<.0001	*	<.0001
1998 Slave Point	0.0022	0.1219	0.2739	0.3967	0.0062	0.9158	0.3239	0.0036	<.0001	0.0004	<.0001	<.0001	<.0001	*

Table 11. Probabilities of obtaining a greater t value for t test comparisons between stretched measure mesh sizes (mm). Comparisons are of least squares means of total value (Canadian Dollars) of all market sizes of all dressed whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

i / j	89	114	121	127	133	139
89	*	0.7707	0.1689	0.9208	0.0212	0.0046
114	0.7707	*	0.0904	0.6634	0.0461	0.0115
121	0.1689	0.0904	*	0.1338	<.0001	<.0001
127	0.9208	0.6634	0.1338	*	0.0038	0.0004
133	0.0212	0.0461	<.0001	0.0038	*	0.5237
139	0.0046	0.0115	<.0001	0.0004	0.5237	*

Table 12. Probabilities of obtaining a greater t value for t test comparisons amongst combinations of stretched measure mesh sizes (mm) and years. Comparisons are of least squares means of total value (Canadian Dollars) of all market sizes of all dressed whitefish caught per net lift. Underlined comparisons are not significantly different at alpha = 0.05 .

Probabilities of obtaining a greater t value for the null hypothesis : Least Squares Mean(i) = Least Squares Mean(j)

	i / j	1997 89 mm	1997 114 mm	1997 121 mm	1997 127 mm	1997 133 mm	1997 139 mm	1998 89 mm	1998 114 mm	1998 121 mm	1998 127 mm	1998 133 mm	1998 139 mm
1997 -	89 mm	*	0.8250	0.0057	0.1621	0.9662	0.9226	0.0032	0.0218	0.0550	0.0670	0.9598	0.4968
1997 -	114 mm	0.8250	*	0.0104	0.2497	0.8208	0.8637	0.0062	0.0380	0.0899	0.1097	0.8361	0.3443
1997 -	121 mm	0.0057	0.0104	*	0.0535	0.0005	0.0006	0.9231	0.5193	0.2928	0.1971	0.0011	<.0001
1997 -	127 mm	0.1621	0.2497	0.0535	*	0.0623	0.0719	0.0314	0.1947	0.4174	0.5160	0.0868	0.0079
1997 -	133 mm	0.9662	0.8208	0.0005	0.0623	*	0.9400	0.0002	0.0034	0.0148	0.0170	0.9897	0.3416
1997 -	139 mm	0.9226	0.8637	0.0006	0.0719	0.9400	*	0.0002	0.0040	0.0173	0.0198	0.9548	0.3057
1998 -	89 mm	0.0032	0.0062	0.9231	0.0314	0.0002	0.0002	*	0.4379	0.2297	0.1438	0.0004	<.0001
1998 -	114 mm	0.0218	0.0380	0.5193	0.1947	0.0034	0.0040	0.4379	*	0.6666	0.5161	0.0060	0.0003
1998 -	121 mm	0.0550	0.0899	0.2928	0.4174	0.0148	0.0173	0.2297	0.6666	*	0.8468	0.0225	0.0018
1998 -	127 mm	0.0670	0.1097	0.1971	0.5160	0.0170	0.0198	0.1438	0.5161	0.8468	*	0.0266	0.0019
1998 -	133 mm	0.9598	0.8361	0.0011	0.0868	0.9897	0.9548	0.0004	0.0060	0.0225	0.0266	*	0.3667
1998 -	139 mm	0.4968	0.3443	<.0001	0.0079	0.3416	0.3057	<.0001	0.0003	0.0018	0.0019	0.3667	*

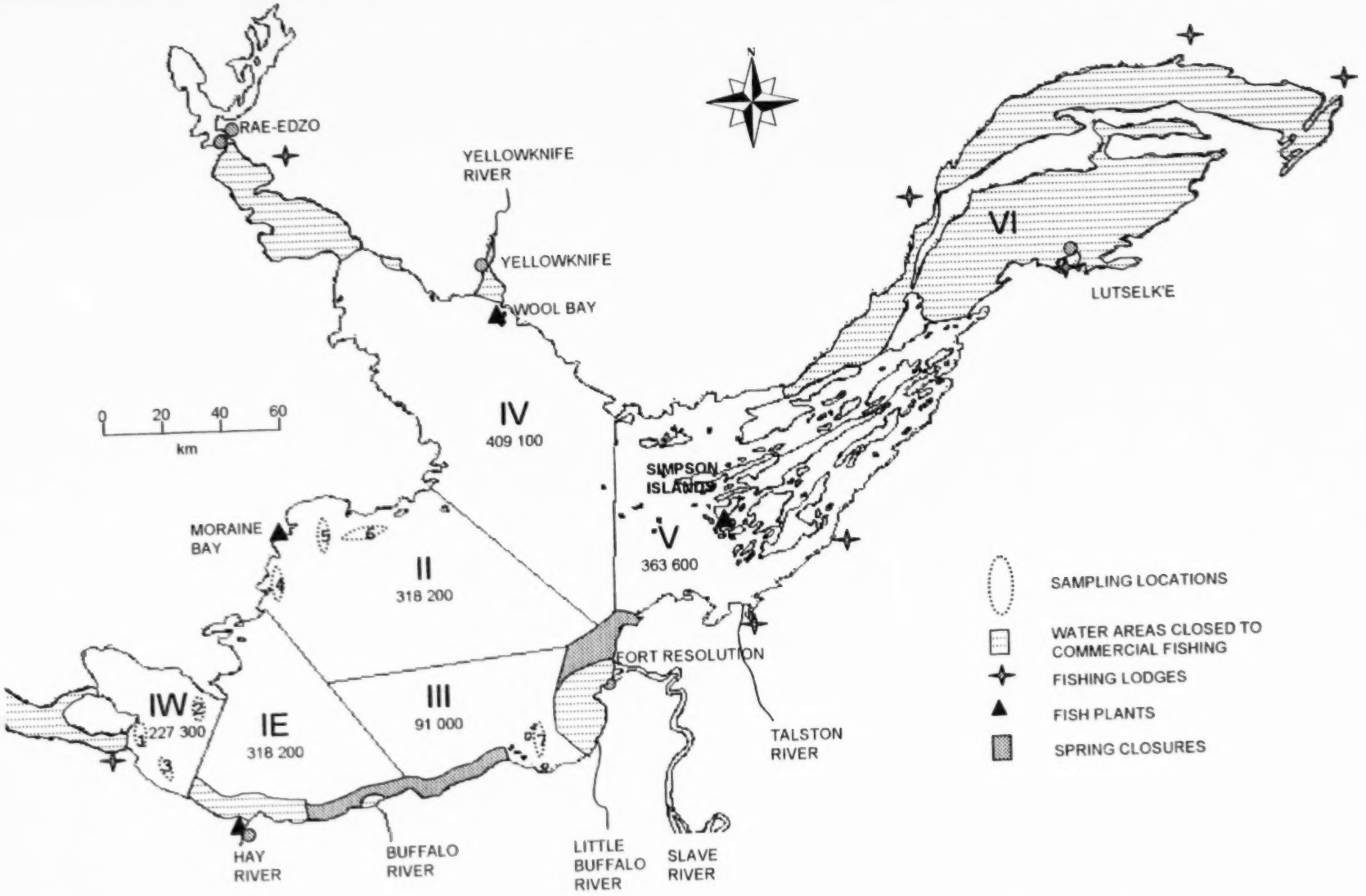

Figure 1. Map of Great Slave Lake showing the administrative areas and quotas (kg), areas closed to commercial fishing, the location of the fish plants and fishing lodges and the sampling locations of this study (1. Mackenzie Mouth, 2. Slave Point, 3. Pte. de Roch, 4. Jones Point, 5. Lonely Bay, 6. Long Island and 7. Paulette Bay).

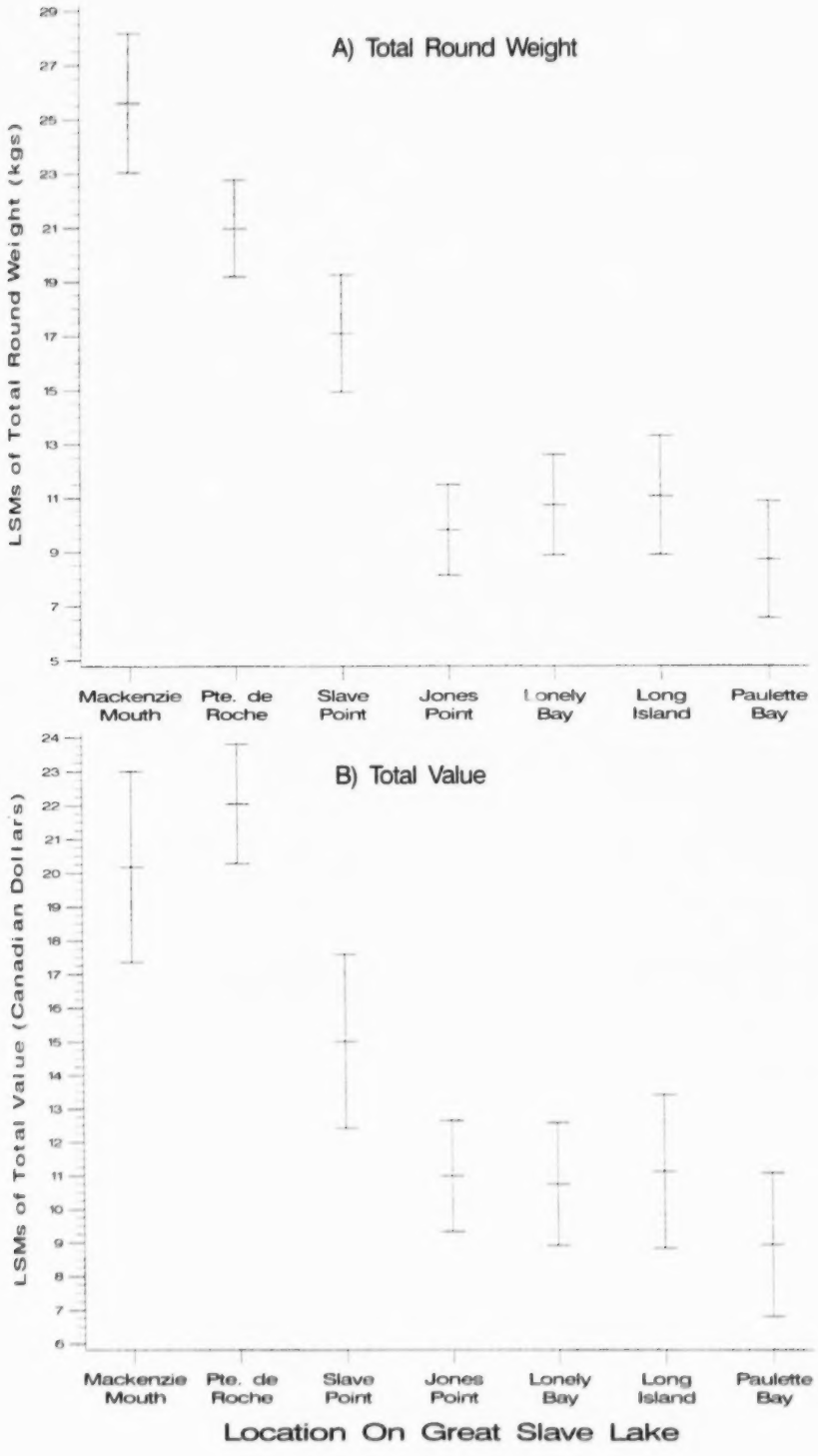

Figure 2. Least squares means (+/− 95 % CI) of total round weight (kgs) and total value in Canadian Dollars of all whitefish caught per net lift at each location.

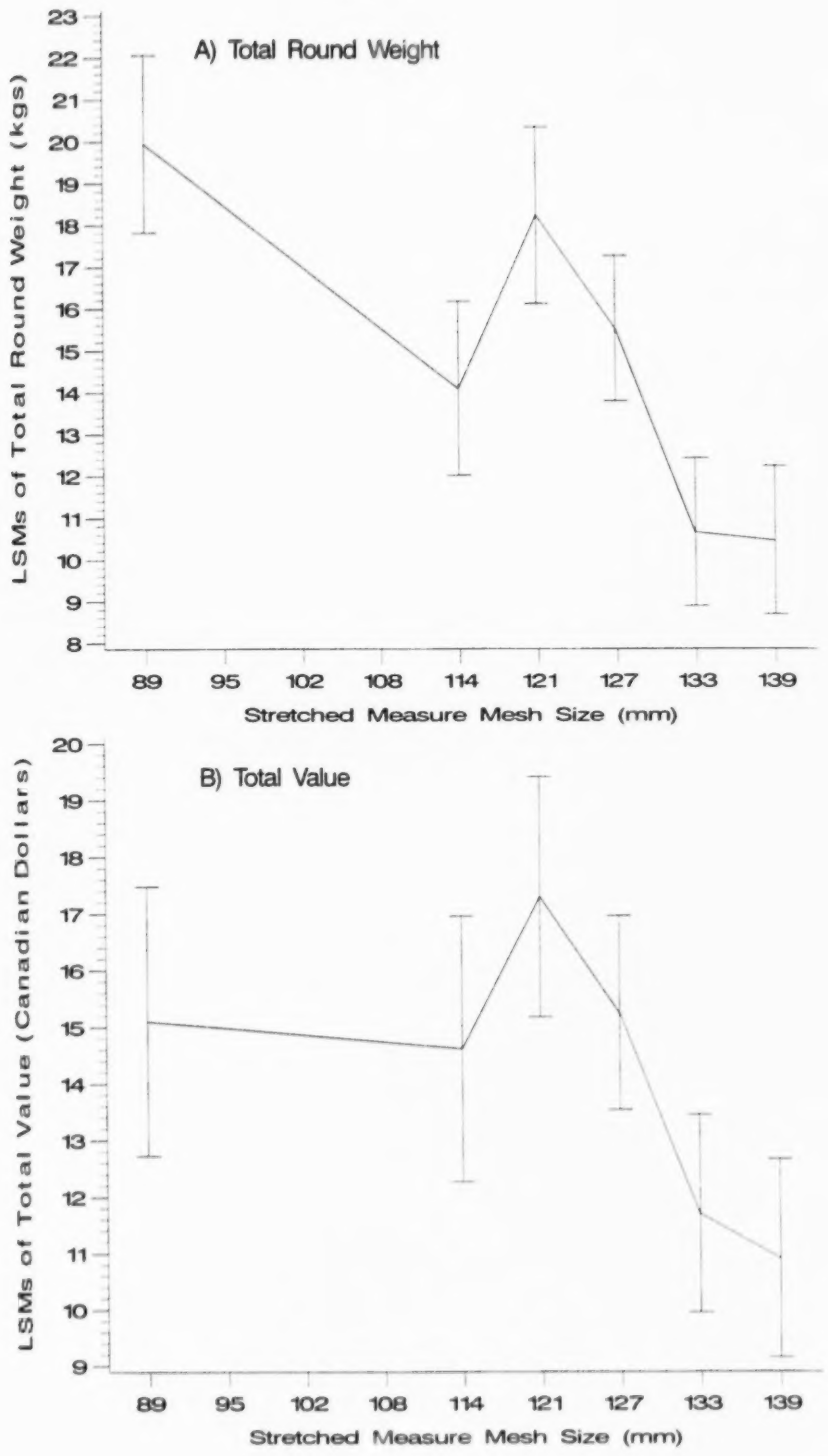

Figure 3. Least squares means (+/− 95 % CI) of total round weight (kgs) and total value in Canadian Dollars of all whitefish caught per net lift in each mesh size (mm).

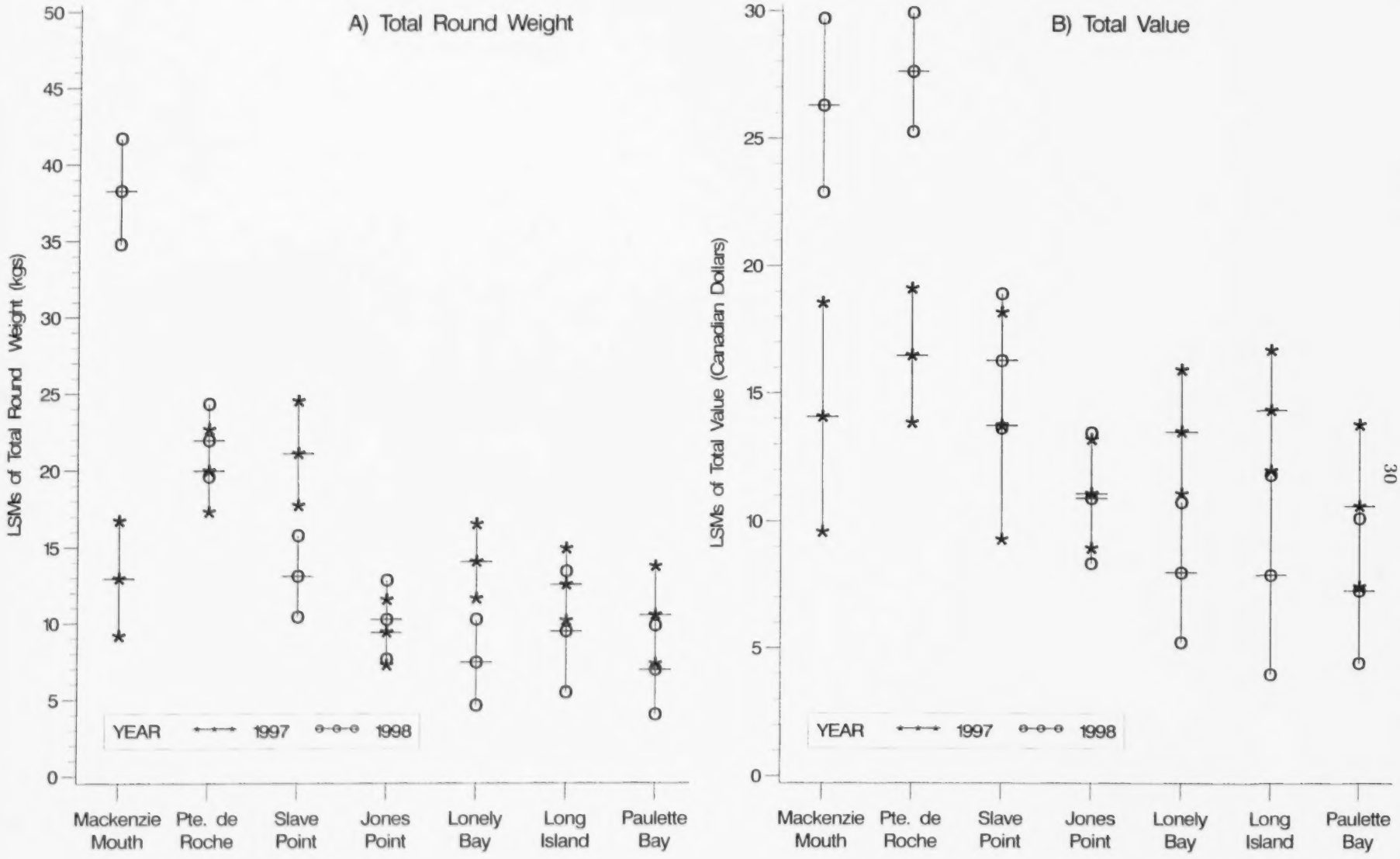

Figure 4. Least squares means (+/– 95 % CI) of total round weight (kgs) and total value in Canadian Dollars of all whitefish caught per net lift at each location in 1997 and 1998.

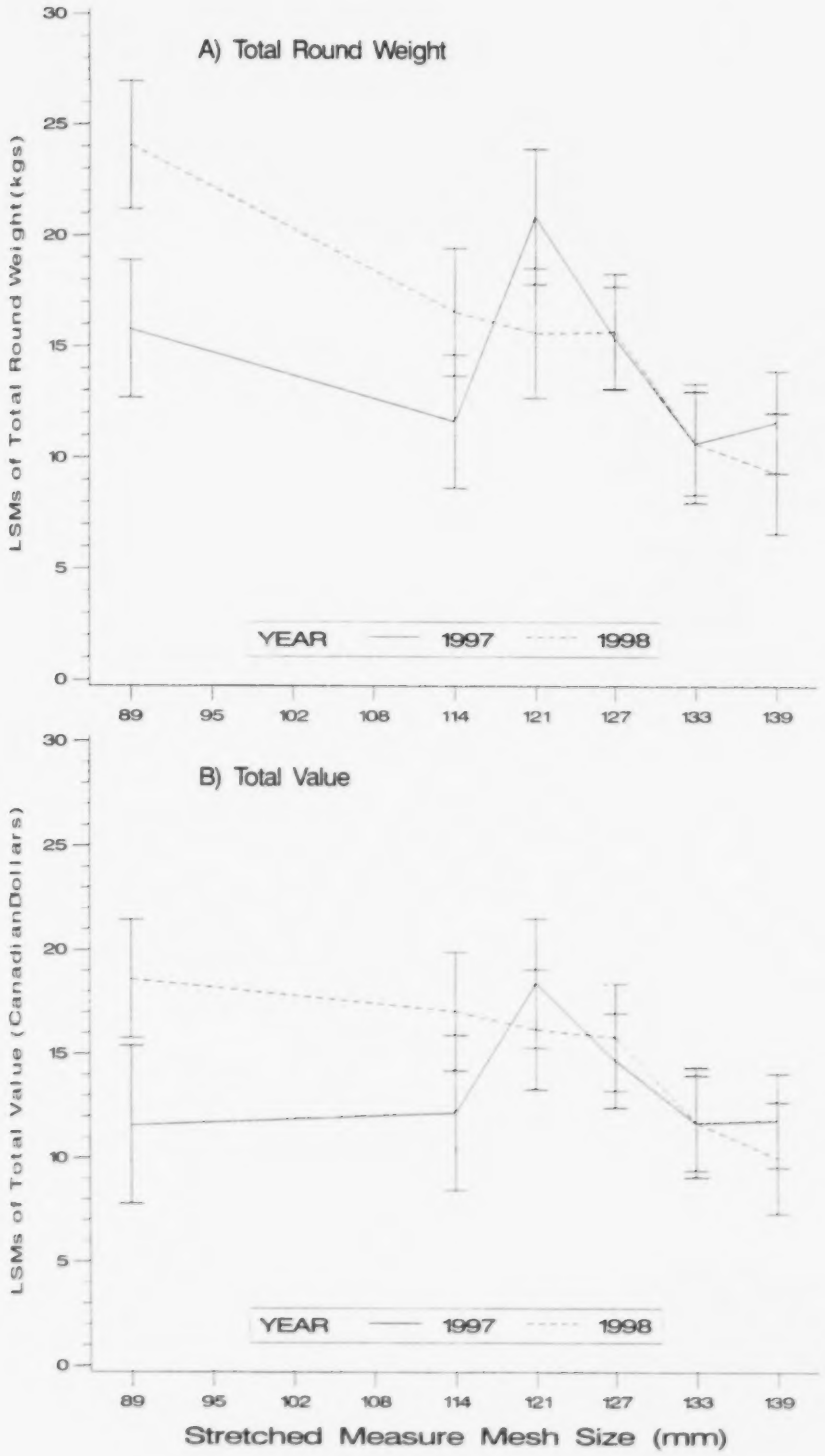

Figure 5. Least squares means (+/– 95 % CI) of total round weight (kgs) and total value in Canadian Dollars of all whitefish caught per net lift in each mesh size (mm) in 1997 and 1998.

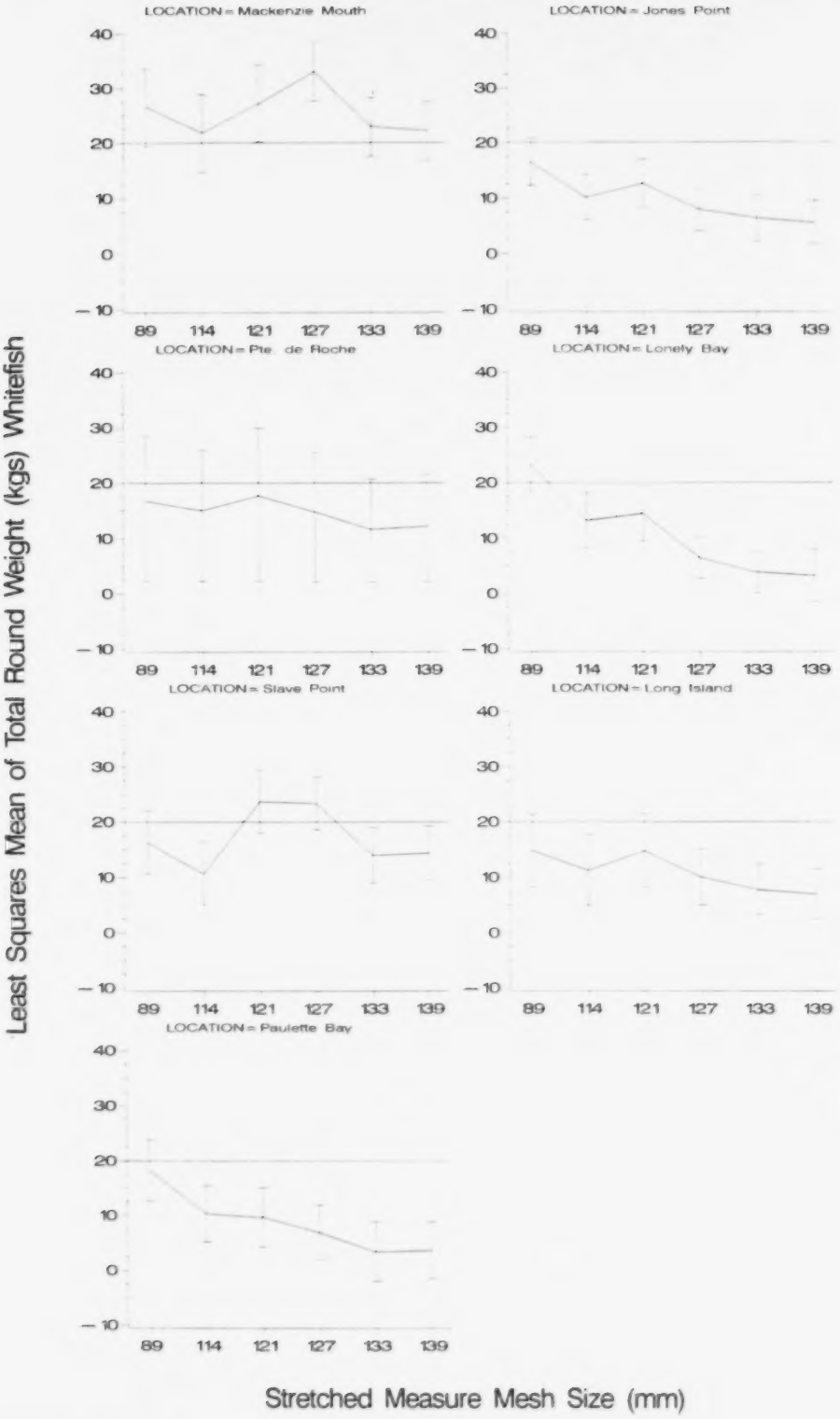

Figure 6. Least squares means (+/– 95 % CI) of total round weight (kgs) of all whitefish caught by each mesh size (mm) at 7 sampling locations on Great Slave Lake. A reference line occurs at 20 kgs round weight.

Appendix 1. Summary of gillnet gang set duration (hours) by year, location and gang type, Great Slave Lake. Stretched measure mesh sizes (mm) of each gang type are 1) 89, 114, 121, 127, 133, 139 : 2) 127, 133, 139 : 3) 114, 133, 139 : 4) 114, 127, 133, 139 .

Location	Year	Gang Type	Set Duration - One Overnight Period					Set Duration - Greater Than One Overnight Period				
			Number of Gangs	Mean	Min.	Max.	Std. Error	Number of Gangs	Mean	Min.	Max.	Std. Error
Jones Pt.	1997	1	8	20.83	14.42	24.70	1.36	2	47.97	47.88	48.05	0.09
		2	4	21.07	20.25	21.92	0.44	2	48.01	47.92	48.10	0.09
		3	3	22.63	21.15	23.50	0.75	0	.	.	.	.
	1998	1	8	22.92	20.70	26.42	0.72	1	47.03	47.03	47.03	.
		2	2	22.27	18.95	25.58	3.32	0	.	.	.	.
Lonely Bay	1997	1	6	22.67	19.65	24.42	0.72	1	46.85	46.85	46.85	.
		2	6	24.10	21.55	26.58	0.84	2	47.17	47.10	47.23	0.07
	1998	1	7	23.16	19.66	26.53	0.80	1	47.25	47.25	47.25	.
		2	3	23.33	22.08	25.17	0.94	0	.	.	.	.
Long Island	1997	1	6	24.41	21.00	27.50	0.85	0	.	.	.	.
		2	21	23.45	21.78	24.42	0.15	0	.	.	.	.
		4	1	22.85	22.85	22.85	.	0	.	.	.	.
	1998	1	3	21.86	20.92	23.66	0.90	0	.	.	.	.
		2	3	23.16	22.08	24.75	0.81	0	.	.	.	.
Mackenzie Mouth	1997	1	3	20.35	16.47	26.93	3.31	0	.	.	.	.
		2	3	20.86	15.78	28.03	3.69	0	.	.	.	.
	1998	1	4	22.14	17.00	31.22	3.21	0	.	.	.	.
		2	2	22.90	22.88	22.92	0.02	0	.	.	.	.
Paulette Bay	1997	1	3	22.24	20.08	23.65	1.10	2	56.20	43.82	68.57	12.38
		2	0	.	.	.	.	2	55.59	43.66	67.52	11.93
	1998	1	8	23.79	21.17	25.83	0.54	0	.	.	.	.
		2	5	24.18	22.08	26.33	0.86	0	.	.	.	.
Pte. de Roche	1997	1	8	22.65	21.08	24.45	0.42	0	.	.	.	.
	1998	1	9	22.88	22.25	23.33	0.10	0	.	.	.	.
		2	3	23.64	23.33	24.25	0.31	0	.	.	.	.
Slave Point	1997	1	2	23.03	22.53	23.53	0.50	2	73.30	47.17	99.43	26.13
		2	2	22.65	22.12	23.18	0.53	1	100.13	100.13	100.13	.
	1998	1	5	22.07	14.25	25.58	2.01	3	51.47	46.58	54.42	2.46
Total Number of Gangs Set for Each Combination of Gang Type and Year	1997	1	36	Grand Total 1997 = 76				7	Grand Total 1997 = 14			
		2	36					7				
		3	3					0				
		4	1					0				
	1998	1	44	Grand Total 1998 = 62				5	Grand Total 1998 = 5			
		2	18					0				
		3	0					0				
		4	0					0				

Appendix 2. Least squares means and standard errors of total round weight (kgs) of all whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1997	.	.	14.3267	0.5517
1998	.	.	15.3165	0.5686
.	Jones Point	.	9.7858	0.8402
.	Lonely Bay	.	10.7122	0.9304
.	Long Island	.	10.9535	1.1583
.	Mackenzie Mouth	.	25.5860	1.2822
.	Paulette Bay	.	8.6938	1.0806
.	Pte. de Roche	.	20.9485	0.8928
.	Slave Point	.	17.0713	1.0804
.	.	89	19.9344	1.0588
.	.	114	14.0960	1.0399
.	.	121	18.2355	1.0573
.	.	127	15.5384	0.8696
.	.	133	10.6595	0.8846
.	.	139	10.4655	0.8889
1997	Jones Point	.	9.3572	1.0741
1997	Lonely Bay	.	14.0165	1.2260
1997	Long Island	.	12.4906	1.1922
1997	Mackenzie Mouth	.	12.9181	1.8939
1997	Paulette Bay	.	10.4819	1.6060
1997	Pte. de Roche	.	19.9528	1.3392
1997	Slave Point	.	21.0695	1.6956
1998	Jones Point	.	10.2143	1.2923
1998	Lonely Bay	.	7.4078	1.3999
1998	Long Island	.	9.4164	1.9863
1998	Mackenzie Mouth	.	38.2540	1.7289
1998	Paulette Bay	.	6.9057	1.4462
1998	Pte. de Roche	.	21.9442	1.1811
1998	Slave Point	.	13.0730	1.3392
1997	.	89	15.7828	1.5502
1997	.	114	11.6303	1.4980
1997	.	121	20.8607	1.5280
1997	.	127	15.4049	1.1494
1997	.	133	10.6615	1.1583
1997	.	139	11.6197	1.1451

Appendix 2 Continued. Least squares means and standard errors of total round weight of all whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1998	.	89	24.0860	1.4426
1998	.	114	16.5618	1.4426
1998	.	121	15.6104	1.4618
1998	.	127	15.6719	1.3053
1998	.	133	10.6576	1.3372
1998	.	139	9.3113	1.3600
.	Jones Point	89	16.4872	2.1315
.	Jones Point	114	10.0324	2.0457
.	Jones Point	121	12.5598	2.1869
.	Jones Point	127	7.8402	1.9330
.	Jones Point	133	6.2882	2.0834
.	Jones Point	139	5.5068	1.9560
.	Lonely Bay	89	23.2568	2.4797
.	Lonely Bay	114	13.1286	2.4797
.	Lonely Bay	121	14.3979	2.4797
.	Lonely Bay	127	6.4332	1.8415
.	Lonely Bay	133	3.8372	1.8939
.	Lonely Bay	139	3.2193	2.3956
.	Long Island	89	14.7842	3.2803
.	Long Island	114	11.2506	3.2013
.	Long Island	121	14.7909	3.2803
.	Long Island	127	10.0566	2.5216
.	Long Island	133	7.8028	2.2586
.	Long Island	139	7.0358	2.2523
.	Mackenzie Mouth	89	26.4990	3.5432
.	Mackenzie Mouth	114	21.7790	3.5432
.	Mackenzie Mouth	121	27.1500	3.5432
.	Mackenzie Mouth	127	33.0250	2.6784
.	Mackenzie Mouth	133	22.8854	2.6784
.	Mackenzie Mouth	139	22.1779	2.6784
.	Paulette Bay	89	18.2326	2.7878
.	Paulette Bay	114	10.3063	2.5876
.	Paulette Bay	121	9.6648	2.7164
.	Paulette Bay	127	6.9091	2.4797
.	Paulette Bay	133	3.3999	2.7164
.	Paulette Bay	139	3.6501	2.5810

Appendix 2 Continued. Least squares means and standard errors of total round weight of all whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
.	Pte. de Roche	89	23.9615	2.2542
.	Pte. de Roche	114	21.4590	2.2542
.	Pte. de Roche	121	25.4190	2.2542
.	Pte. de Roche	127	21.1744	2.1175
.	Pte. de Roche	133	16.4133	2.1175
.	Pte. de Roche	139	17.2637	2.1175
.	Slave Point	89	16.3197	2.8409
.	Slave Point	114	10.7166	2.8409
.	Slave Point	121	23.6664	2.8409
.	Slave Point	127	23.3301	2.4010
.	Slave Point	133	13.9897	2.5054
.	Slave Point	139	14.4051	2.4010
1997	Jones Point	89	9.9956	2.9340
1997	Jones Point	114	6.8625	2.6784
1997	Jones Point	121	16.1451	3.0927
1997	Jones Point	127	9.6360	2.3196
1997	Jones Point	133	5.6900	2.2503
1997	Jones Point	139	7.8141	2.3956
1997	Lonely Bay	89	26.3471	3.5068
1997	Lonely Bay	114	17.8107	3.5068
1997	Lonely Bay	121	21.8714	3.5068
1997	Lonely Bay	127	8.8750	2.3956
1997	Lonely Bay	133	4.9810	2.3956
1997	Lonely Bay	139	4.2137	2.3956
1997	Long Island	89	15.1517	3.7878
1997	Long Island	114	10.1529	3.5068
1997	Long Island	121	20.0302	3.7878
1997	Long Island	127	12.0045	1.9781
1997	Long Island	133	8.2626	1.7856
1997	Long Island	139	9.3416	1.7534
1997	Mackenzie Mouth	89	8.5767	5.3568
1997	Mackenzie Mouth	114	8.8317	5.3568
1997	Mackenzie Mouth	121	15.2650	5.3568
1997	Mackenzie Mouth	127	19.2250	3.7878
1997	Mackenzie Mouth	133	13.6092	3.7878
1997	Mackenzie Mouth	139	12.0008	3.7878

Appendix 2 Continued. Least squares means and standard errors of total round weight of all whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1997	Paulette Bay	89	15.4625	4.6391
1997	Paulette Bay	114	12.5320	4.1493
1997	Paulette Bay	121	13.9410	4.1493
1997	Paulette Bay	127	9.5190	3.5068
1997	Paulette Bay	133	5.4619	3.5068
1997	Paulette Bay	139	5.9753	3.5068
1997	Pte. de Roche	89	17.2525	3.2803
1997	Pte. de Roche	114	15.0313	3.2803
1997	Pte. de Roche	121	25.4719	3.2803
1997	Pte. de Roche	127	21.8125	3.2803
1997	Pte. de Roche	133	18.5288	3.2803
1997	Pte. de Roche	139	21.6200	3.2803
1997	Slave Point	89	17.6938	4.6391
1997	Slave Point	114	10.1912	4.6391
1997	Slave Point	121	33.3002	4.6391
1997	Slave Point	127	26.7621	3.5068
1997	Slave Point	133	18.0968	3.7878
1997	Slave Point	139	20.3727	3.5068
1998	Jones Point	89	22.9789	3.0927
1998	Jones Point	114	13.2022	3.0927
1998	Jones Point	121	8.9744	3.0927
1998	Jones Point	127	6.0444	3.0927
1998	Jones Point	133	6.8864	3.5068
1998	Jones Point	139	3.1994	3.0927
1998	Lonely Bay	89	20.1664	3.5068
1998	Lonely Bay	114	8.4464	3.5068
1998	Lonely Bay	121	6.9243	3.5068
1998	Lonely Bay	127	3.9914	2.7975
1998	Lonely Bay	133	2.6935	2.9340
1998	Lonely Bay	139	2.2250	4.1493
1998	Long Island	89	14.4167	5.3568
1998	Long Island	114	12.3483	5.3568
1998	Long Island	121	9.5517	5.3568
1998	Long Island	127	8.1087	4.6391
1998	Long Island	133	7.3430	4.1493
1998	Long Island	139	4.7300	4.1493

Appendix 2 Continued. Least squares means and standard errors of total round weight of all whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1998	Mackenzie Mouth	89	44.4213	4.6391
1998	Mackenzie Mouth	114	34.7263	4.6391
1998	Mackenzie Mouth	121	39.0350	4.6391
1998	Mackenzie Mouth	127	46.8250	3.7878
1998	Mackenzie Mouth	133	32.1617	3.7878
1998	Mackenzie Mouth	139	32.3550	3.7878
1998	Paulette Bay	89	21.0028	3.0927
1998	Paulette Bay	114	8.0806	3.0927
1998	Paulette Bay	121	5.3886	3.5068
1998	Paulette Bay	127	4.2993	3.5068
1998	Paulette Bay	133	1.3380	4.1493
1998	Paulette Bay	139	1.3250	3.7878
1998	Pte. de Roche	89	30.6706	3.0927
1998	Pte. de Roche	114	27.8867	3.0927
1998	Pte. de Roche	121	25.3661	3.0927
1998	Pte. de Roche	127	20.5362	2.6784
1998	Pte. de Roche	133	14.2979	2.6784
1998	Pte. de Roche	139	12.9075	2.6784
1998	Slave Point	89	14.9456	3.2803
1998	Slave Point	114	11.2419	3.2803
1998	Slave Point	121	14.0325	3.2803
1998	Slave Point	127	19.8981	3.2803
1998	Slave Point	133	9.8825	3.2803
1998	Slave Point	139	8.4375	3.2803

Appendix 3. Least squares means and standard errors of total value in Canadian Dollars of all market sizes of all dressed whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1997	.	.	13.3889	0.6093
1998	.	.	14.8897	0.5609
.	Jones Point	.	10.9794	0.8287
.	Lonely Bay	.	10.7455	0.9177
.	Long Island	.	11.1160	1.1425
.	Mackenzie Mouth	.	20.1723	1.4096
.	Paulette Bay	.	8.9414	1.0658
.	Pte. de Roche	.	22.0294	0.8806
.	Slave Point	.	14.9911	1.2917
.	.	89	15.0977	1.1879
.	.	114	14.6112	1.1715
.	.	121	17.2903	1.0598
.	.	127	15.2434	0.8577
.	.	133	11.6912	0.8725
.	.	139	10.9019	0.8768
1997	Jones Point	.	11.0642	1.0594
1997	Lonely Bay	.	13.4921	1.2092
1997	Long Island	.	14.3297	1.1759
1997	Mackenzie Mouth	.	14.0569	2.2450
1997	Paulette Bay	.	10.5995	1.5840
1997	Pte. de Roche	.	16.4640	1.3209
1997	Slave Point	.	13.7158	2.2202
1998	Jones Point	.	10.8946	1.2746
1998	Lonely Bay	.	7.9988	1.3807
1998	Long Island	.	7.9022	1.9592
1998	Mackenzie Mouth	.	26.2877	1.7052
1998	Paulette Bay	.	7.2833	1.4264
1998	Pte. de Roche	.	27.5947	1.1649
1998	Slave Point	.	16.2663	1.3209
1997	.	89	11.5858	1.9025
1997	.	114	12.1747	1.8614
1997	.	121	18.4061	1.5536
1997	.	127	14.6860	1.1337
1997	.	133	11.6799	1.1425
1997	.	139	11.8008	1.1295

Appendix 3 Continued. Least squares means and standard errors of total value in Canadian Dollars of all market sizes of all dressed whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1998	.	89	18.6097	1.4228
1998	.	114	17.0476	1.4228
1998	.	121	16.1744	1.4418
1998	.	127	15.8008	1.2875
1998	.	133	11.7025	1.3189
1998	.	139	10.0030	1.3414
.	Jones Point	89	14.0727	2.1023
.	Jones Point	114	11.6022	2.0177
.	Jones Point	121	15.9158	2.1570
.	Jones Point	127	9.8142	1.9065
.	Jones Point	133	7.9758	2.0549
.	Jones Point	139	6.4955	1.9292
.	Lonely Bay	89	18.9614	2.4458
.	Lonely Bay	114	13.0558	2.4458
.	Lonely Bay	121	16.4117	2.4458
.	Lonely Bay	127	7.9893	1.8163
.	Lonely Bay	133	4.4522	1.8680
.	Lonely Bay	139	3.6023	2.3628
.	Long Island	89	10.4807	3.2354
.	Long Island	114	9.6922	3.1575
.	Long Island	121	17.2173	3.2354
.	Long Island	127	12.1941	2.4871
.	Long Island	133	9.1279	2.2277
.	Long Island	139	7.9836	2.2215
.	Mackenzie Mouth	89	12.5075	5.1157
.	Mackenzie Mouth	114	19.6188	3.4947
.	Mackenzie Mouth	121	20.3348	3.4947
.	Mackenzie Mouth	127	26.0804	2.6417
.	Mackenzie Mouth	133	22.4288	2.6417
.	Mackenzie Mouth	139	20.0639	2.6417
.	Paulette Bay	89	14.0434	2.7496
.	Paulette Bay	114	11.1573	2.5522
.	Paulette Bay	121	10.7838	2.6792
.	Paulette Bay	127	9.0679	2.4458
.	Paulette Bay	133	4.1022	2.6792
.	Paulette Bay	139	4.4939	2.5456

Appendix 3 Continued. Least squares means and standard errors of total value in Canadian Dollars of all market sizes of all dressed whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
.	Pte. de Roche	89	22.5871	2.2233
.	Pte. de Roche	114	24.0840	2.2233
.	Pte. de Roche	121	25.3402	2.2233
.	Pte. de Roche	127	22.1295	2.0885
.	Pte. de Roche	133	18.4962	2.0885
.	Pte. de Roche	139	19.5391	2.0885
.	Slave Point	89	13.0312	3.0977
.	Slave Point	114	13.0679	4.8532
.	Slave Point	121	15.0284	3.0977
.	Slave Point	127	19.4286	2.3681
.	Slave Point	133	15.2550	2.4711
.	Slave Point	139	14.1353	2.3681
1997	Jones Point	89	10.7520	2.8939
1997	Jones Point	114	7.6669	2.6417
1997	Jones Point	121	20.3500	3.0504
1997	Jones Point	127	11.7302	2.2878
1997	Jones Point	133	6.8492	2.2195
1997	Jones Point	139	9.0366	2.3628
1997	Lonely Bay	89	19.3584	3.4588
1997	Lonely Bay	114	16.3346	3.4588
1997	Lonely Bay	121	24.3533	3.4588
1997	Lonely Bay	127	10.8623	2.3628
1997	Lonely Bay	133	5.5305	2.3628
1997	Lonely Bay	139	4.5137	2.3628
1997	Long Island	89	13.1944	3.7360
1997	Long Island	114	12.2740	3.4588
1997	Long Island	121	25.6372	3.7360
1997	Long Island	127	14.4176	1.9510
1997	Long Island	133	10.4183	1.7612
1997	Long Island	139	10.0365	1.7294
1997	Mackenzie Mouth	89	4.4198	9.1512
1997	Mackenzie Mouth	114	11.8117	5.2835
1997	Mackenzie Mouth	121	16.1669	5.2835
1997	Mackenzie Mouth	127	20.6099	3.7360
1997	Mackenzie Mouth	133	17.8208	3.7360
1997	Mackenzie Mouth	139	13.5126	3.7360

Appendix 3 Continued. Least squares means and standard errors of total value in Canadian Dollars of all market sizes of all dressed whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1997	Paulette Bay	89	9.7873	4.5756
1997	Paulette Bay	114	12.8199	4.0925
1997	Paulette Bay	121	14.6777	4.0925
1997	Paulette Bay	127	12.5124	3.4588
1997	Paulette Bay	133	6.5862	3.4588
1997	Paulette Bay	139	7.2134	3.4588
1997	Pte. de Roche	89	13.4713	3.2354
1997	Pte. de Roche	114	13.0794	3.2354
1997	Pte. de Roche	121	16.5936	3.2354
1997	Pte. de Roche	127	16.2357	3.2354
1997	Pte. de Roche	133	17.6193	3.2354
1997	Pte. de Roche	139	21.7847	3.2354
1997	Slave Point	89	10.1173	5.2835
1997	Slave Point	114	11.2365	9.1512
1997	Slave Point	121	11.0643	5.2835
1997	Slave Point	127	16.4337	3.4588
1997	Slave Point	133	16.9349	3.7360
1997	Slave Point	139	16.5083	3.4588
1998	Jones Point	89	17.3935	3.0504
1998	Jones Point	114	15.5376	3.0504
1998	Jones Point	121	11.4815	3.0504
1998	Jones Point	127	7.8981	3.0504
1998	Jones Point	133	9.1025	3.4588
1998	Jones Point	139	3.9544	3.0504
1998	Lonely Bay	89	18.5644	3.4588
1998	Lonely Bay	114	9.7770	3.4588
1998	Lonely Bay	121	8.4701	3.4588
1998	Lonely Bay	127	5.1163	2.7592
1998	Lonely Bay	133	3.3740	2.8939
1998	Lonely Bay	139	2.6908	4.0925
1998	Long Island	[illegible]	7.7670	5.2835
1998	Long Island	114	7.1104	5.2835
1998	Long Island	121	8.7974	5.2835
1998	Long Island	127	9.9705	4.5756
1998	Long Island	133	7.8375	4.0925
1998	Long Island	139	5.9307	4.0925

Appendix 3 Continued. Least squares means and standard errors of total value in Canadian Dollars of all market sizes of all dressed whitefish caught per net lift for all combinations of sampling years, sampling locations and mesh sizes, Great Slave Lake.

Year	Location	Stretched Measure Mesh Size (mm)	Least Squares Mean	Standard Error
1998	Mackenzie Mouth	89	20.5951	4.5756
1998	Mackenzie Mouth	114	27.4259	4.5756
1998	Mackenzie Mouth	121	24.5027	4.5756
1998	Mackenzie Mouth	127	31.5508	3.7360
1998	Mackenzie Mouth	133	27.0369	3.7360
1998	Mackenzie Mouth	139	26.6151	3.7360
1998	Paulette Bay	89	18.2996	3.0504
1998	Paulette Bay	114	9.4947	3.0504
1998	Paulette Bay	121	6.8898	3.4588
1998	Paulette Bay	127	5.6233	3.4588
1998	Paulette Bay	133	1.6183	4.0925
1998	Paulette Bay	139	1.7744	3.7360
1998	Pte. de Roche	89	31.7030	3.0504
1998	Pte. de Roche	114	35.0886	3.0504
1998	Pte. de Roche	121	34.0869	3.0504
1998	Pte. de Roche	127	28.0232	2.6417
1998	Pte. de Roche	133	19.3730	2.6417
1998	Pte. de Roche	139	17.2935	2.6417
1998	Slave Point	89	15.9451	3.2354
1998	Slave Point	114	14.8993	3.2354
1998	Slave Point	121	18.9925	3.2354
1998	Slave Point	127	22.4236	3.2354
1998	Slave Point	133	13.5751	3.2354
1998	Slave Point	139	11.7623	3.2354

Appendix 4. Least squares means of individual round weight (kgs) by location, fork length (mm) by location and number of whitefish caught per net lift by location.

Location	LSM Round Weight (kgs.)	Standard Error	LSM Fork Length (mm)	Standard Error	LSM Number of Whitefish Caught	Standard Error
Lonely Bay	0.820	.0119	386.50	1.487	14.34	0.873
Paulette Bay	0.953	.0172	399.16	2.144	10.19	0.954
Long Island	0.986	.0116	405.93	1.446	11.76	1.095
Jones Point	1.074	.0102	411.76	1.270	9.94	0.780
Pte. de Roche	1.101	.0068	415.66	0.853	20.03	0.874
Slave Point	1.126	.0095	420.37	1.180	15.51	1.058
Mackenzie Mouth	1.290	.0114	440.10	1.417	20.10	1.255

Appendix 5. Least squares means of individual round weight (kgs) by mesh size, fork length (mm) by mesh size and number of whitefish caught per net lift by mesh size.

Mesh Size (mm)	LSM Round Weight (kgs.)	Standard Error	LSM Fork Length (mm)	Standard Error	LSM Number of Whitefish Caught	Standard Error
89 mm	0.774	0.0077	376.70	0.966	26.39	1.026
114 mm	0.967	0.0097	403.57	1.215	14.66	1.017
121 mm	1.035	0.0092	411.33	1.152	17.17	1.026
127 mm	1.141	0.0092	423.01	1.148	12.70	0.810
133 mm	1.177	0.0128	425.78	1.594	8.27	0.809
139 mm	1.208	0.0143	427.72	1.779	8.12	0.803